Longline Fishing for Tuna in the Central Equatorial Pacific, 1954

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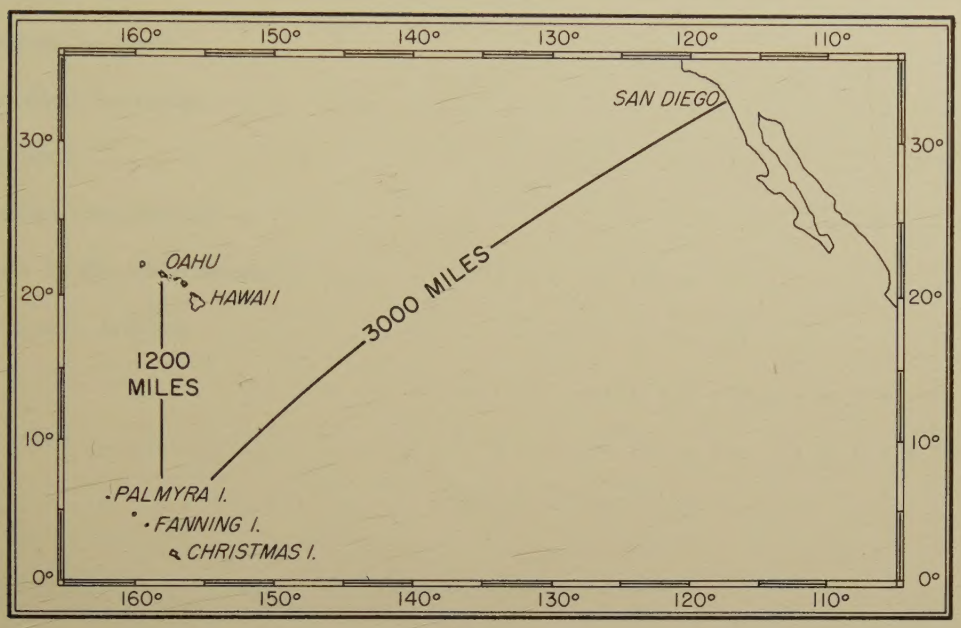

LONGLINE FISHING FOR TUNA IN THE CENTRAL EQUATORIAL PACIFIC, 1954

By

Edwin S. Iversen, Fishery Research Biologist

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Pacific Oceanic Fishery Investigations
Honolulu, T. H.

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One of the chief goals of the Pacific Oceanic Fishery Investigations (POFI) is to evaluate the equatorial Pacific tuna resources and to make the results of this appraisal available to American fishermen. In order to locate the regions of greatest tuna abundance and define their boundaries it has been necessary to do experimental fishing throughout vast areas of the equatorial Pacific. Our principal sampling tool has been the longline, which is used commercially to great advantage by the Japanese. Our research program has also of necessity included an evaluation of the longline method and of means of increasing its efficiency.

The present report is the fifth in a series and includes information obtained during experimental and commercial operations in the equatorial area in 1954. The earlier reports (Murphy and Shomura 1953a, 1953b, 1955, and Shomura and Murphy 1955) included processed data from cruises of 1950 through 1953, with some information from Japanese commercial fishing operations. The highlights of the 1954 fishing are:

(1) First commercial effort by American fishermen based on POFI research.

(2) First use of steel-mainline gear.

(3) Continued fishing for nearly 1 year in the Line Islands area, mainly near Christmas Island.

(4) Sharp difference in seasonal catch rates from previous years.

Longline catch statistics for the central equatorial Pacific during 1954 came from many sources. There were 2 POFI research cruises and 11 fishing trips by 6 American commercial vessels to the central equatorial region during the year. The John R. Manning (cruise 20) operated entirely within the Line Islands area; the Charles H. Gilbert (cruise 15) fished three north-south lines of stations, one close to Baja California at 119°W. longitude, one that crossed the Equator on 110°W. longitude, and a third which crossed the Equator on 155°W. longitude. The American commercial vessels operated in the vicinity of the Line Islands. Two of the commercial cruises made during 1954 were of immediate interest to the fishing industry so a general account of the venture was published (Iversen and Murphy 1955). In addition, longline fishing was initiated at American Samoa. The overall operation from January to April 1954 was reported by Van Campen (1954); the catch rates will be discussed in this report. Lastly, we have utilized the available data from Japanese longline fishing near the Equator.

In order to avoid needless repetition the present report does not include as detailed an analysis of the 1954 fishing results as was presented for the years 1950 through 1953 in the four previous numbers of the series. For instance, little space will be devoted in this report to the discussion of tuna other than yellowfin since other species were not taken in sufficient quantity to be of commercial interest. Operational details and the complete catch records for fishing cruises during 1954 are given in the Appendix. For the sake of simplicity, only the vernacular names of the various species in the catch will be used in this report. The scientific name for each species is listed in table 1 of the Appendix.

ACKNOWLEDGMENTS

Appreciation is extended to the captains and crewmen of both the commercial and POFI vessels for their cooperation and to the scientific personnel who made the observations, in many instances under adverse conditions. Deserving of special thanks are the following commercial vessel captains and owners: S. Jangaard, L. Jangaard, A. Ottness, E. Oswald, H. Sperling, and J. Parsons. The bathythermograph temperature sections and the Christmas Island temperature graph were prepared by T. S. Austin.

METHODS OF COLLECTION AND ANALYSIS OF DATA

The nature and extent of our observations varied during 1954. On the two POFI experimental cruises observations on the catch and fishing operations were obtained by trained personnel. The commercial vessels carried only a single government observer or none at all; in the latter case the vessel captain recorded information in a log provided by POFI (fig. 1).

PACIFIC OCEANIC FISHERY INVESTIGATIONS
LONGLINE FISHING LOG

Vessel _____ Noon position _____ (Lat.) _____ (Long.) Dir. of set _____ Date _____

Noon: Wind force _____ Wind direction _____ RPM of set _____

TIME OF SETTING AND HAULING

First basket set	Last basket set	First basket hauled	Last basket hauled

GEAR

Fabric	
Number baskets set	Number baskets lost
Wire	
Number reels set	Number reels lost

At the first day's fishing sketch one basket or reel of each type of gear used. Record any modifications of gear on this form.

Bait: Kind(s) _____

Bait hooking method: Single _____ Double _____ (Check one)

Bait condition: Good _____ Fair _____ Poor _____ (Check one)

CATCH

Species	Number not shark bitten	Number shark bitten	Approx. average weight	Remarks
Yellowfin				
Bigeye				
Skipjack				
Albacore				
Black marlin				
White marlin				
Striped marlin				
Sailfish				
Sharks				

Recorder: _____ 11/3/54

Figure 1.--Pacific Oceanic Fishery Investigations' Longline Fishing Log.

Also, certain facilities and equipment, such as a bathythermograph winch, were not available on the commercial boats. As a result, the information from this source was not as complete as that from the POFI research vessels.

There were differences in the gear used from cruise to cruise both in respect to design and materials. To some extent these variations affected the catch rates. The longline gear with fabric mainline had as few as 6 and as many as 15 droppers per basket. Shomura and Murphy (1955) found that catch rates of yellowfin tuna in terms of fish per 100 hooks taken on gear with 11 droppers per basket should be multiplied by 1.52 to make them equivalent to catch rates on gear with 6 droppers per basket. Catch rates are given in terms of 11-hook gear, except in our comparison of American and Japanese fishing results at different longitudes. In this case rates of American vessels have been converted to 6-hook equivalents to make them comparable to the Japanese catch rates. The length of the droppers on 6-hook gear used on cruise 15 of the Charles H. Gilbert was 10 fathoms as compared with the usual 3 fathoms, but the difference is not believed to have markedly altered the catch rates, for the efficiency of long and short droppers has been compared and no significant difference demonstrated (Shomura and Murphy 1955). On this same cruise both 1- and 10-fathom float lines were used on some stations (tables 6 and 7 - Appendix), but previous experiments have indicated no significant difference in yellowfin catch rates resulting from the use of different length float lines (Murphy and Shomura 1953b).

Longline gear with the mainline of wire rope was used on two commercial ventures of the Commonwealth (cruises 1 and 2), Oceanic and Brothers (cruises 1 and 2), and one experimental fishing cruise of the John R. Manning (cruise 20). The steel gear was introduced to increase the efficiency of operation of longline fishing. Steel mainline can be spooled on a reel rather than coiled in baskets, which results in a very considerable saving of labor. There is some

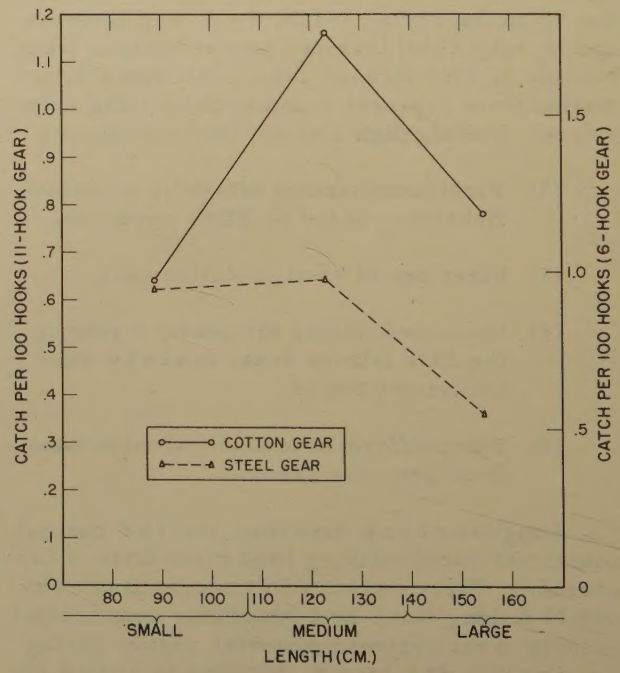

Figure 2.--Comparison of steel and cotton gear yellowfin catch rates by size groups, John R. Manning cruise 20.

indication, however, that the steel gear has a lower catch rate than fabric gear. A comparison of the two, made on John R. Manning cruise 20, shows that the steel line caught about the same number of small yellowfin, but that it caught relatively fewer medium and large yellowfin than the fabric gear (fig. 2). The steel gear probably does not offer the resiliency to the struggles of the fish that the fabric gear does, hence a higher proportion of the larger tunas escape.

The amount of shark damage varies considerably from cruise to cruise. The numbers of shark-damaged yellowfin are included in calculations of abundance for each cruise, but, of course, should not be counted when calculating the number of marketable fish.

VESSEL EFFICIENCY

It has been frequently observed that with equivalent fishing effort some vessels are able to produce good catches while others fishing under seemingly the same conditions and in the same general area do poorly. The reasons for this, perhaps, lie in the skill, experience, etc., of the fishermen involved. In an intensive fishery individual differences in experience will be smoothed out in the seasonal or annual averages. In 1954, only eight vessels took part in longline fishing in the area of study, and one of these made only a single trip; also the waters, and, in some instances, the fishing method, were unfamiliar to the fishermen. Hence it is possible that some of the variation among catches made at different times of the year resulted from differences among vessels and not entirely from a seasonal variation in the abundance of yellowfin.

Despite this possibility, it appears that differences among vessels did not seriously affect the catch rates, since there were only gradual changes in the catch rates between consecutive cruises, and when two or three vessels fished simultaneously, as did the North American and the Alrita, the catch rates were in general similar (fig. 3). The 95-percent fiducial limits estimated by Murphy and Elliott (1954) for longline catch rates, if assigned to the rates of each vessel, would doubtless overlap.

Differences among local fishing areas could also affect the catch rates. In Hawaii, for example, Otsu (1954) found that certain longline boats fished in a certain area whether productive or not, while others fished in areas which were known to be the most productive at a particular season. On the basis of the meager data available from the Line Islands area it appears that yellowfin move around these rather small islands in a more or less random manner. This, coupled with the fact that the vessels moved about from day to day, makes it very doubtful that location of fishing biased the catches.

YELLOWFIN ABUNDANCE

Latitudinal Variation

In February to April 1954 the Charles H. Gilbert (cruise 15) occupied fishing stations on

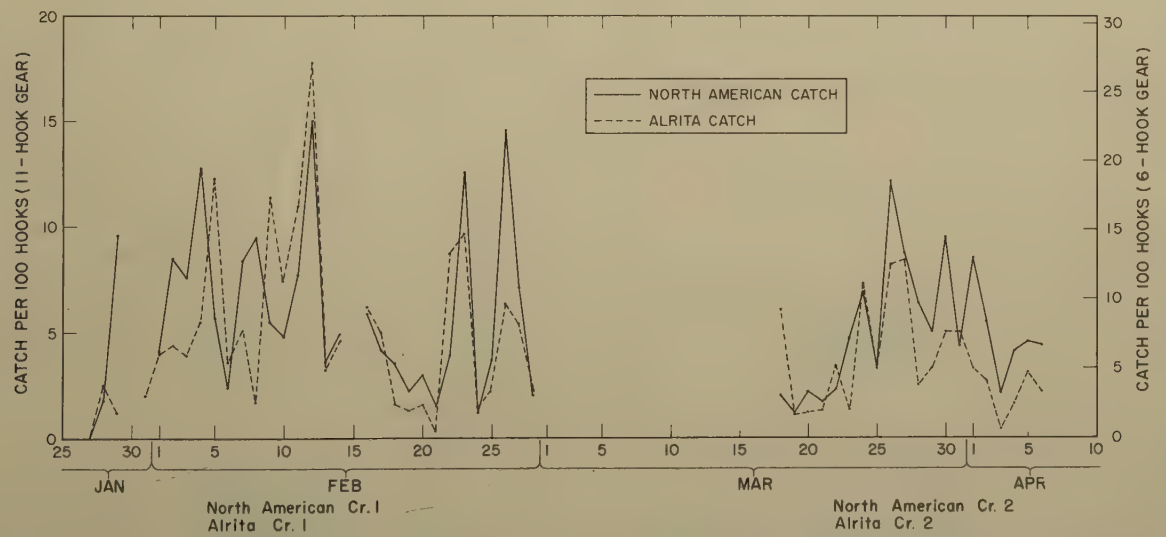

Figure 3.--Daily variability of yellowfin catch between the North American and the Alrita in the Line Islands.

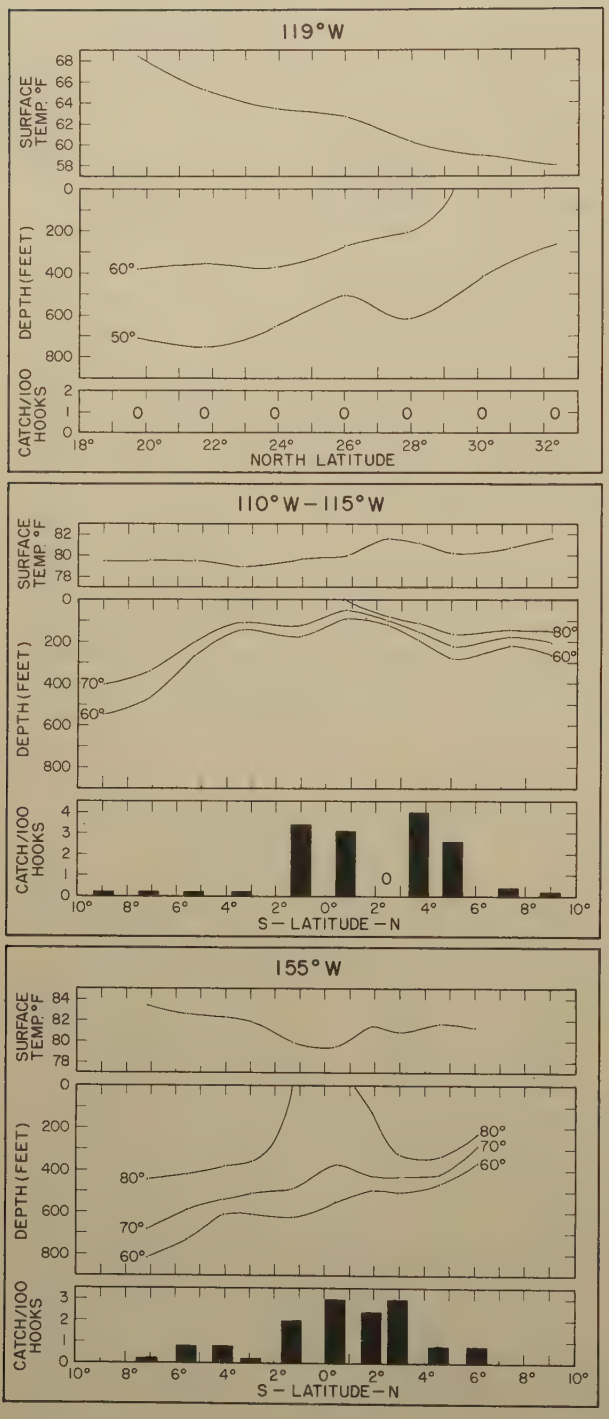

Figure 4.--Variation of yellowfin catches with latitude and temperature on three station lines along 119°W., 110°-115°W., and 155°W. longitude; Charles H. Gilbert cruise 15, February to April. /If no yellowfin were taken a zero is shown at that latitude./

three north-south lines in the eastern and central Pacific. On this cruise 6- and 11-hook gear was fished simultaneously; therefore, 6-hook catch rates have been converted to 11-hook equivalents and averaged with the 11-hook catch rates. The variation of yellowfin catches with latitude and temperature is shown in figure 4. The first series on 119°W. longitude extending from 33°N. to 20°N. latitude yielded no yellowfin. The section on 110°-115°W. longitude, from 10°N. to 10°S. latitude produced the best catches (>2 yellowfin per 100 hooks) between 6°N. and 1°S. latitude. Running north on 155°W. longitude the highest catch rates (>2 yellowfin per 100 hooks) were made between 2°S. and 3°N. latitude. Most of these stations were outside the influence of land (more than 60 miles) so that the catch rates are readily comparable with previous results from the open ocean. The results from along the Equator are consistent with past experience. Shomura and Murphy (1955) found that the center of abundance of yellowfin at several longitudes was at or a little north of the Equator during 1953.

Longitudinal Variation

The Japanese carried out extensive long-line fishing in the equatorial Pacific during 1954. Records of their catches are available (Nomura 1954-55) for each month of the year. It is difficult to compare these data with ours because the Japanese in general fished farther to the north during many months of the year (probably in search of better bigeye catches) than did U.S. fishermen or the POFI research vessels. Nevertheless, certain aspects of seasonal and geographic variation are susceptible to analysis.

The catch rates of American and Japanese vessels are plotted in terms of 6-hook gear for each month of the year in figure 5 for latitudes 11°S. to 10°N. (Table 18 in the Appendix lists the results of the Japanese fishing.) Considering the Japanese data for the area west of 170°W. longitude, the seasonal trend in catch rates is the same as described by Shomura and Murphy (1955), i.e., low catch rates, less than 2 yellowfin per 100 hooks from January to May, slightly higher catch rates in June and July of 2-4 yellowfin per 100 hooks, with a decrease again from August to December to less than 2 yellowfin per 100 hooks.

In comparing the catches west of 170°W. with those of the Line Islands area during 1953, Shomura and Murphy (1955) found evidence of an east-west shift in the equatorial yellowfin population. During 1954 there was some indication of a similar shift in the center of abundance.

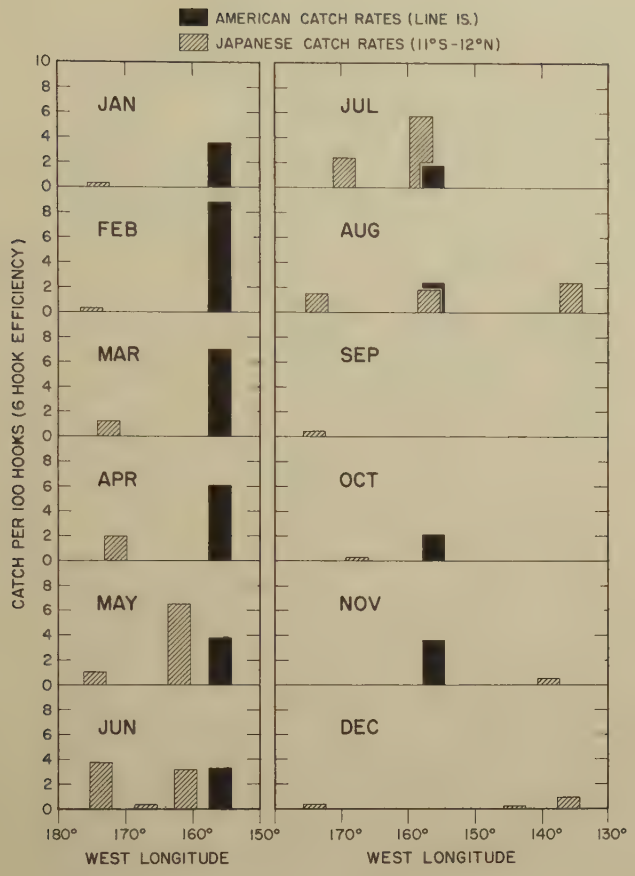

Figure 5.--Catch rates of yellowfin from the equatorial Pacific (11°S.-10°N. latitude) obtained by American and Japanese vessels during 1954.

When the catches were high west of the Line Islands area (around 160°W.) they were lower in the vicinity of the Line Islands and conversely (fig. 5).

During the month of July 1954 Japanese vessels fishing near the Line Islands area experienced markedly higher catch rates than the American vessels. This is difficult to evaluate in view of the wide variability in the very few samples obtained by American vessels during July. However, the Japanese did most of their fishing south and somewhat west of the Americans and used fabric instead of steel gear.

Line Islands

General: A seasonal trend can be seen in the yellowfin catch rates from the vicinity of the Line Islands during 1954 (fig. 6). Starting with high catch rates in February, there was a gradual decrease to a very low level during the latter part of July, early August, and during October. During November there was a slight increase over the summer months, but the rates remained considerably lower than those of the first few months of the year. The catch rates of the Japanese longline vessels based at Pago Pago, American Samoa, show a similar decline (fig. 7) during the early months of 1954 (Van Campen 1954).

This trend in catch rates during 1954 is sharply divergent from past observations, for Shomura and Murphy (1955) found that the greatest abundance in the Line Islands area occurred from July through September during 1951-1953. This dissimilarity in the seasonal trend of catch

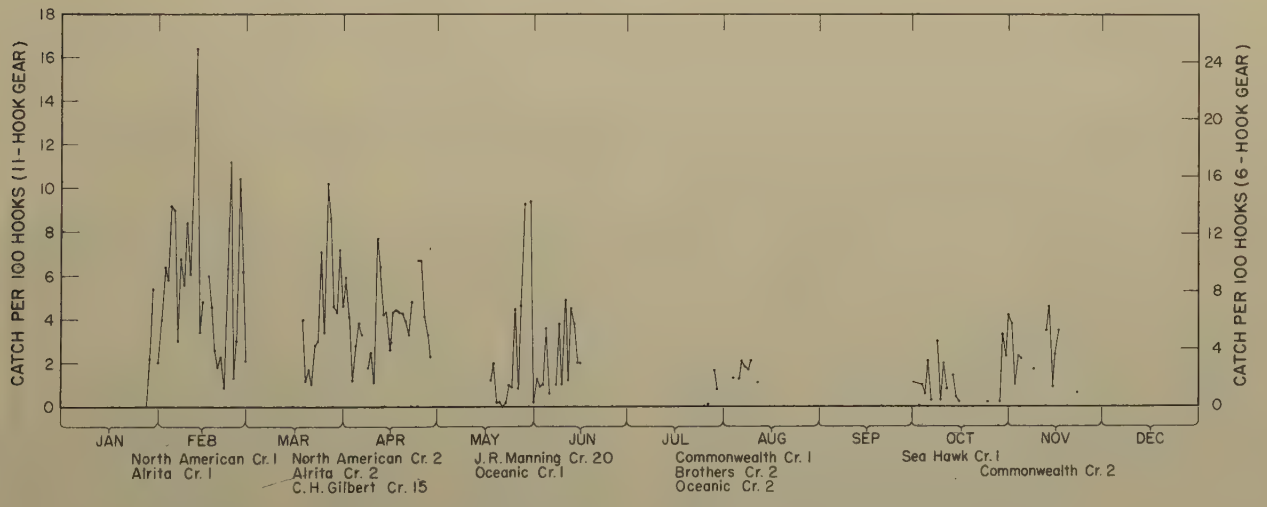

Figure 6.--Daily catch rates for yellowfin in the Line Islands during 1954.

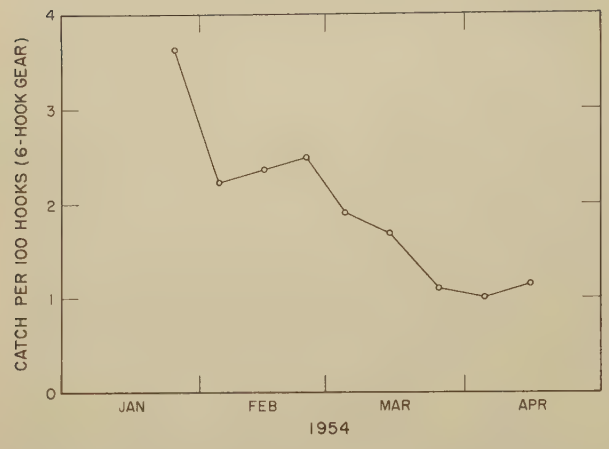

Figure 7.--Yellowfin catch rates by 10-day periods from 0° to 20°S. and 165°W. to 180° by vessels based at Pago Pago, American Samoa. /Data from Van Campen 1954./

rates is good evidence of a change in the abundance or distribution of the yellowfin. The possibility that this change is related to a change in the environment will be considered later.

Discussion of individual cruises: The results of concentrated fishing around Christmas Island by the North American and Alrita during January to March and March to May have already been discussed by Iversen and Murphy (1954). In the former period, yellowfin catches averaged 5.6 but ranged from 0 to 17.8 per 100 hooks for individual stations; in the latter period, they averaged 4.4 but ranged from 0.4 to 12.2 per 100 hooks. As shown by the summary of catch rates according to sectors (figs. 8 and 9) no one area seems to be significantly superior to the rest. We may conclude therefore that during this period the yellowfin were distributed in a somewhat random fashion. Only a few catches were made elsewhere in the Line Islands.

On John R. Manning cruise 20 (fig. 10), in May-June 1954, the best catch rates of 9.3 and 9.4 yellowfin per 100 hooks were made near Fanning and the poorest, 0 to 0.2 yellowfin per 100 hooks, near Palmyra.

On Oceanic cruise 1 (fig. 11), the fishing was generally poor, with an average catch rate of 0.9 for Christmas Island and an average of 1.5 for the seven stations in the vicinity of Fanning Island. The Brothers cruise 2 (fig. 12) occupied only four stations each at Fanning and Christmas Islands, with very low catch rates for both islands. The rate at Fanning averaged 0.9 and that at Christmas 1.0 yellowfin per 100 hooks. On Oceanic cruise 2 (fig. 13), only a single

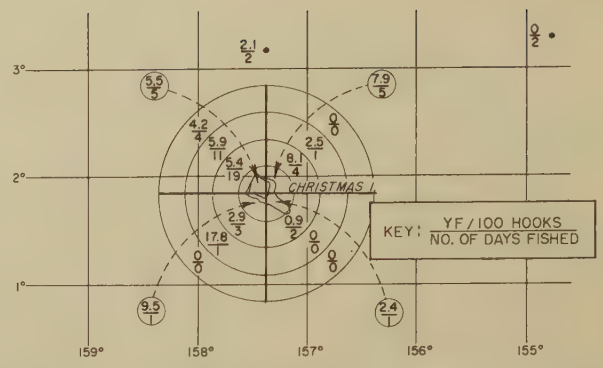

Figure 8.--Jangaard longline fishing (Alrita and North American catches combined), cruise 1, January-March.

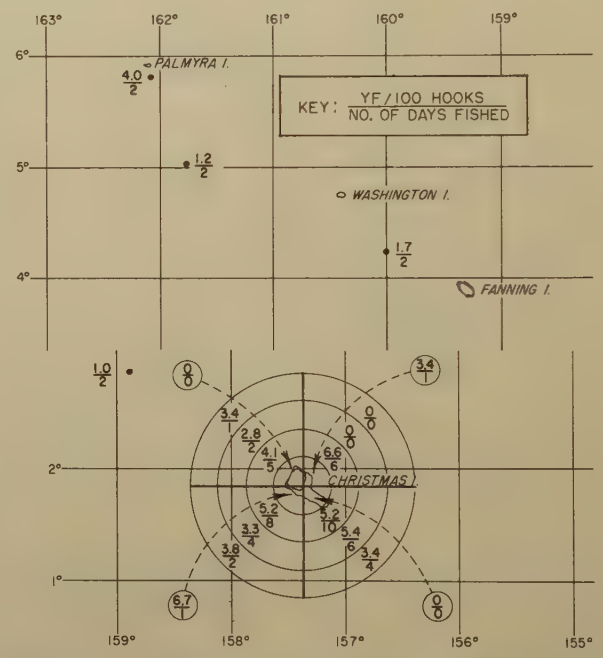

Figure 9.--Jangaard longline fishing (Alrita and North American catches combined), cruise 2, March-May.

station was occupied near Fanning; eight fishing days were spent in the vicinity of Christmas Island and show a high of 3.4 and a low of 0.2 yellowfin per 100 hooks.

On Commonwealth cruise 1 (fig. 14), fishing centered in the vicinity of Christmas Island. A high catch rate of 3.3 and a low of 0 yellowfin per 100 hooks were obtained. The Sea Hawk also fished in the vicinity of Christmas Island with poor results (fig. 15). Her best catch rate of 3.0 yellowfin per 100 hooks was made in the lee

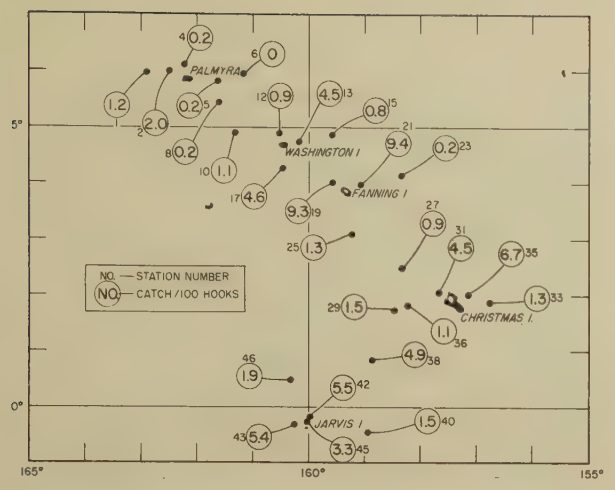

Figure 10.--John R. Manning longline fishing, cruise 20, May-June.

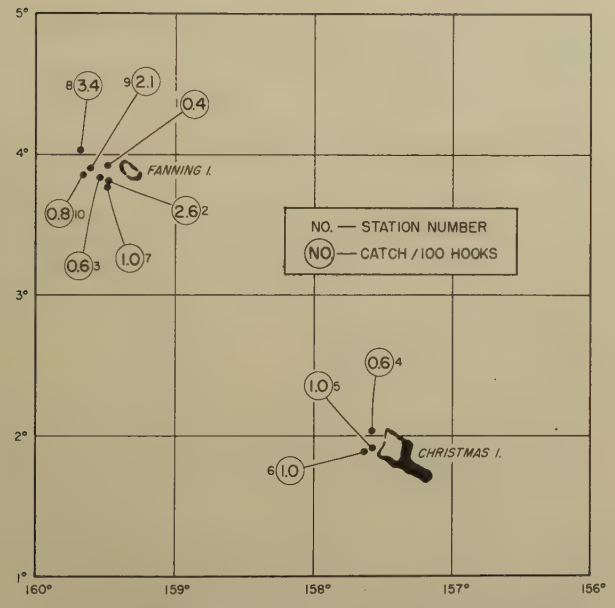

Figure 11.--Oceanic longline fishing, cruise 1, May-June.

of the island. On the second cruise of the Commonwealth fishing was improved, with high catch rates of more than 4 yellowfin per 100 hooks at both Christmas and Fanning Islands and one low catch rate at Palmyra of 0.6 yellowfin per 100 hooks (fig. 16). The average for Fanning Island, 3.0 yellowfin per 100 hooks, was only slightly higher than the average catch rate for Christmas Island, 2.3 yellowfin per 100 hooks.

Although it is difficult to summarize these rather variable and patchy results, we believe

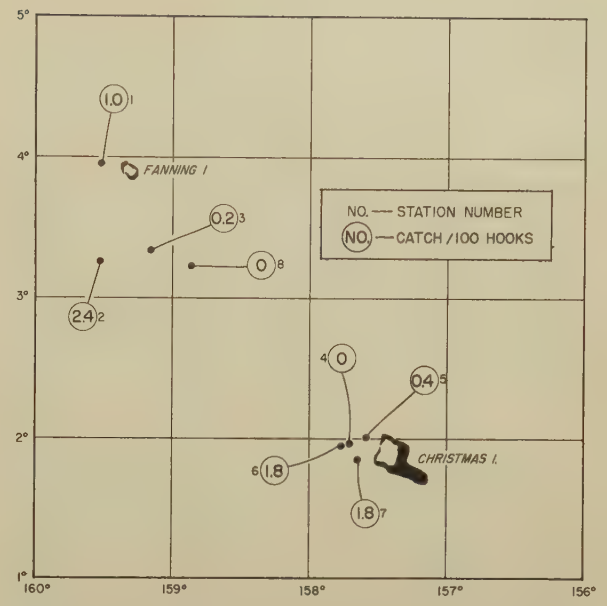

Figure 12.--Brothers longline fishing, cruise 2, July-August.

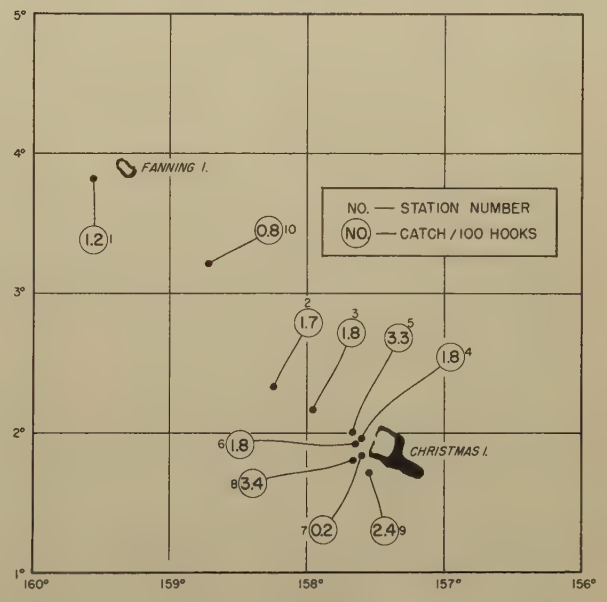

Figure 13.--Oceanic longline fishing, cruise 2, July-August.

they contain two important indications. First, the deep-swimming yellowfin do not appear to congregate on one side of an island, leeward or windward, in preference to the other; and second, although the data do not permit a proper comparison of differences among islands, slightly better catches were made in the vicinity of Fanning Island than at Christmas or the other areas fished (figs. 10, 11, 12, 16).

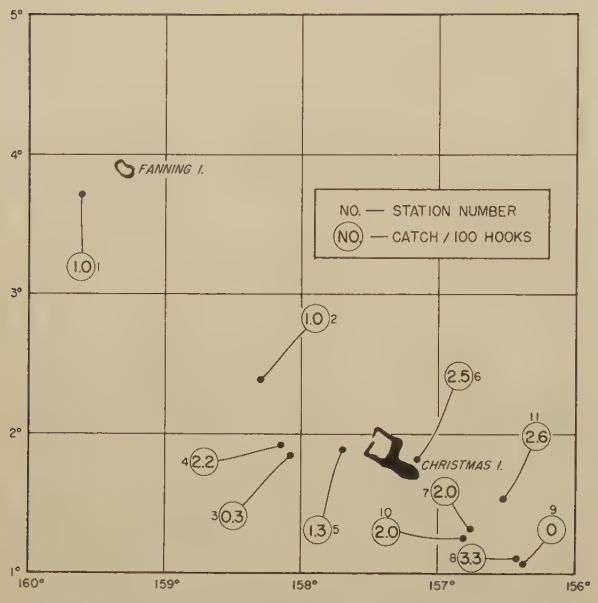

Figure 14.--Commonwealth longline fishing, cruise 1, July-August.

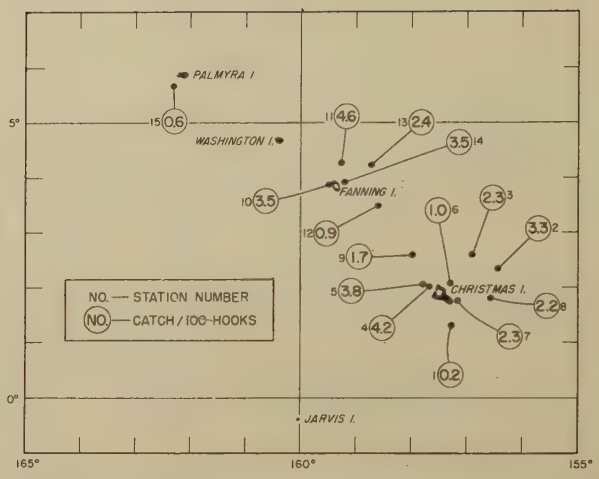

Figure 16.--Commonwealth longline fishing, cruise 2, October-November.

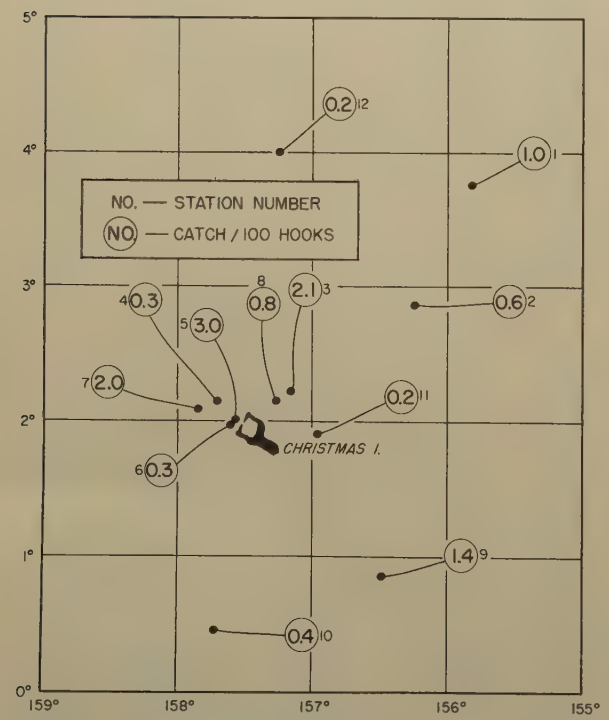

Figure 15.--Sea Hawk longline fishing, October.

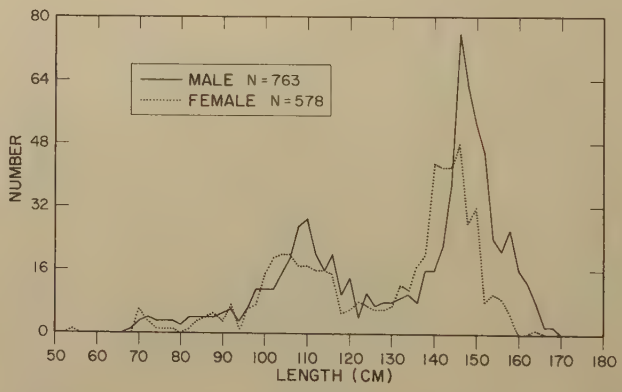

Figure 17.--Yellowfin size distributions by sex taken on fabric gear in the Line Islands area during 1954 (data in Appendix table 17).

YELLOWFIN CATCH COMPOSITION

There are no apparent differences in the sex ratio or size distribution between yellowfin caught during 1954 and those caught in past years (Murphy and Shomura 1955, fig. 11 and Shomura and Murphy 1955, fig. 11) that would help explain the decreased abundance during 1954 and the absence of the midsummer upswing in catch rates. As usual the males were predominant in number, especially in the very large fish (fig. 17).

OBSERVATIONS ON THE ENVIRONMENT

In conjunction with the experimental fishing, extensive observations were made on the sea temperature. In the long-term approach these observations are intended to help explain seasonal and annual fluctuations in catch rates of tuna. Tester (1956) points out a high positive correlation between sea temperatures and yellowfin catch. He does not regard the temperature change as the direct cause of the change in tuna abundance; rather, that temperature indicates the age of the water subsequent to upwelling. Since upwelling brings to the surface water low in temperature and high in nutrients, he regards the coolest water as newly upwelled and warmer water as water that has been longer at the surface and has remained in the area sufficiently long to permit tuna forage to develop in it.

Since November 1953 the U. S. Fish and Wildlife Service has obtained weather and hydrographic data from the weather station on Christmas Island. At that time instruments and aid were given to improve the station maintained by a plantation weather observer at the village of London on the lee (west) side of the island. Differences between observations made at the island station and in the open ocean are being examined. At present it appears that on-shore water temperatures are consistently lower than those off-shore, but they may provide an index of oceanic conditions.

Surface temperatures obtained at the Christmas Island station during 1954 show a trend generally similar to the trend in the catch rates of yellowfin (fig. 18). Both sea surface temperatures and yellowfin catch rates were relatively high early in the year and both were relatively low during the late summer and fall months.

Tester (1956, fig. 3) used yellowfin catches and temperatures collected in the equatorial Pacific over several years to define the temperature-yellowfin relationship. In this report we are dealing with a large number of observations taken within one year and all from the Line Islands area. Since the same interpretation can be given to the two somewhat dissimilar lots of data, the hypothesis that there is a significant relationship between the temperature of the water and the abundance of yellowfin tuna appears reliable.

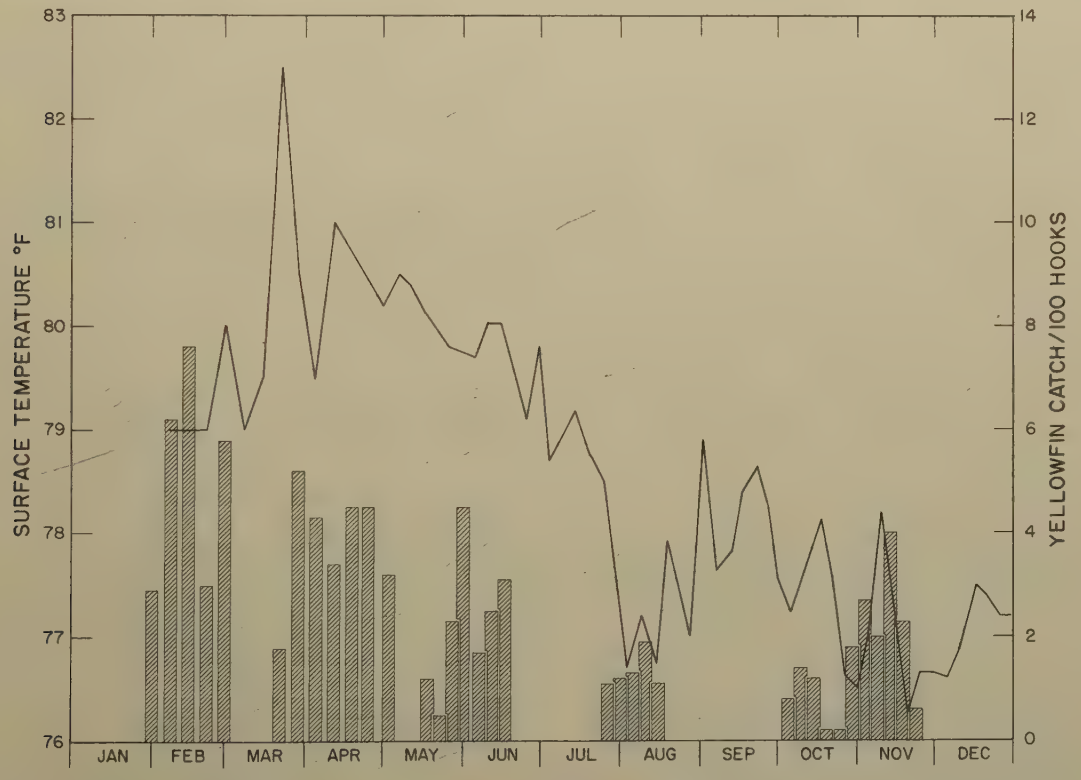

Figure 18.--Surface temperatures at Christmas Island and Line Islands yellowfin catches during 1954 by 5-day periods. [/] Only single weekly temperature observations are available through March 12. [/]

SHARKS AND SHARK DAMAGE

The depredation on hooked yellowfin tuna by sharks requires brief examination, since it affects the monetary return to fishermen from any longline venture. Not all tunas which are shark damaged are unsaleable, however, since some may be only superficially damaged and hence acceptable to canneries. Consequently, the records kept by POFI observers tend to exaggerate the loss from this source since the extent of damage to each shark-bitten fish was usually not evaluated.

The loss due to sharks during 1954 does not differ greatly from previous years. In 1954 an average of 20 percent of hooked yellowfin were damaged. One extreme occurred on a cruise of the Oceanic when 46 percent of the yellowfin caught were either partially mutilated or totally destroyed by sharks. The lowest figure for any cruise in 1954 was the 10 percent damage reported by the North American on cruise 1.

The relationship of the percentage of shark damaged to hooked yellowfin and the longline catch rates of all species of sharks (white-tipped, silky, great blue, and bonito) taken during 1954 in the Line Islands region is illustrated in figure 19.

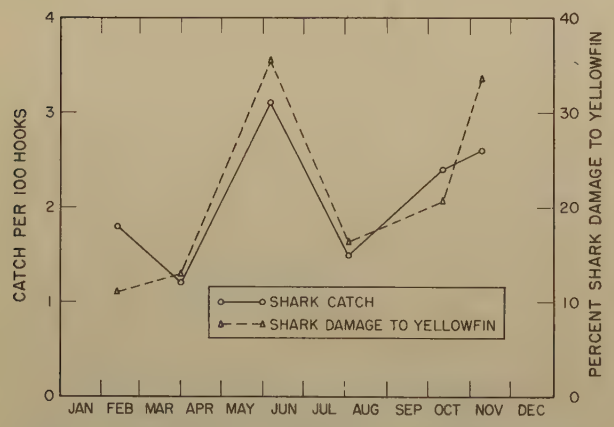

Figure 19.--Shark catch rates on longlines and percentage of shark damage to hooked yellowfin in the Line Islands area during 1954.

The plotted points are mid-points of fishing periods, and where two or more vessels fished together the average shark catch rate and shark damage are used. As would be expected the amount of shark damage varies directly with the shark catch rates. Shark catch rates, however, are not correlated with the abundance of yellowfin (compare figs. 19 and 6).

SUMMARY

1. There were thirteen longline fishing cruises to the central equatorial Pacific during 1954. Most of these were commercial ventures to the vicinity of the Line Islands.

2. The year 1954 marked some first events in the central equatorial Pacific: (1) the first commercial attempts to longline by American fishermen, (2) the first use of steel longline gear, and (3) first concentrated year-around fishing in the Line Islands area.

3. The seasonal trend of catch rates was lowest during August and October 1954, the period at which catch rates were highest for previous years.

4. The lack of distinct variation in yellowfin catch rates between different localities close to the Line Islands indicated a random distribution of the fish in respect to each individual island.

5. The sex ratio and size distribution in the yellowfin catch of 1954 were similar to the previous years.

6. A correlation between sea temperature and the catch of deep-swimming yellowfin was observed again in 1954, with the higher catch rates being associated with warmer surface temperatures.

7. The amount of shark damage to hooked yellowfin was about the same as in previous years and varied directly with the abundance of sharks.

LITERATURE CITED

IVERSEN, EDWIN S. and G. I. MURPHY
1955. What the Jangaard longline venture found in mid-Pacific. Pacific Fisherman 53(4):22, 25, 27.

MANN, HERBERT J.
1955. Construction details of improved tuna long-line gear used by Pacific Oceanic Fishery Investigations. U. S. Fish and Wildlife Service, Comm. Fish. Rev. 17(12):1-10.

MURPHY, GARTH I. and K. C. ELLIOTT
1954. Variability of longline catches of yellowfin tuna. U. S. Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries No. 119, 30 pp.

MURPHY, GARTH I. and R. S. SHOMURA
1953a. Longline fishing for deep-swimming tunas in the central Pacific, 1950-1951. U. S. Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries No. 98, 47 pp.

1953b. Longline fishing for deep-swimming tunas in the central Pacific, January-June 1952. U. S. Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries No. 108, 32 pp.

1955. Longline fishing for deep-swimming tunas in the central Pacific, August-November 1952. U. S. Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries No. 137, 42 pp.

NOMURA, TOSHIZO (Editor)
1954-55. Survey of the high-seas tuna fisheries based on landings at Misaki, Tokyo, and Yaizu. Published monthly by Kanagawa Prefecture Fisheries Experiment Station in Tuna Fishing, 9:1-25; 10:1-31; 11:1-31; 12:1-40; 13:1-44; 14-15:1-30; 31-54; 16:1-30; 17:1-34; 18:13-40; 19:1-16; 20:1-36.

OTSU, TAMIO
1954. Analysis of the Hawaiian long-line fishery, 1948-52. U. S. Fish and Wildlife Service, Comm. Fish. Rev. 16(9):1-17 (also issued as Separate No. 376).

SHOMURA, RICHARD S. and G. I. MURPHY
1955. Longline fishing for deep-swimming tunas in the central Pacific, 1953. U. S. Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries No. 157, 70 pp.

TESTER, ALBERT L.
1956. Recent equatorial tuna research. Pan American Fisherman 10(8):10, 11, 21.

VAN CAMPEN, WILVAN G.
1954. Tuna fishing at American Samoa, January-April 1954. U. S. Fish and Wildlife Service, Comm. Fish. Rev. 16(11):1-9 (also issued as Separate No. 382).

APPENDIX

Annotated List of 1954 Cruises

Vessels: North American and Alrita (Jangaard expedition)
Cruise No.: 1
Cruise period: January 12 to March 7, 1954
Gear: The longline gear used differed only slightly from the most recent 11-hook gear used by POFI (Mann 1955). The major differences were the lengthening of the mainline to 1620 feet and the addition of 4 extra droppers, making a total of 15 droppers per basket.

Vessels: North American and Alrita (Jangaard expedition)
Cruise No.: 2
Cruise period: March 13 to May 15, 1954
Gear: The gear used was identical with the gear used on the first Jangaard expedition.

Vessel: Charles H. Gilbert
Cruise No.: 15
Cruise period: February 18 to April 26, 1954
Gear: Equal numbers of POFI 6- and 11-hook cotton gear were fished at all stations. The lengths of the droppers were 10 fathoms on the 6-hook gear and 3 fathoms on the 11-hook gear. Ten-fathom float lines were used on both gear types except at stations 7-32, at which both 1- and 10-fathom float lines were used.

Vessels: Oceanic and Brothers
Cruise No.: 1
Cruise period: May 20 to June 23, 1954
Gear: The mainlines used by both vessels were constructed of 5/64" hard lay Hackensack stainless steel cable made up into reels 1600 fathoms in length. The reels of cable were joined by means of Brummel hooks. A pair of bullet swivels 1 fathom apart were inserted every 45 fathoms along the mainline. Two sets of 3 brass beads were pressed on to the mainline between the pair of swivels. The droppers were attached between the swivels and beads. The gear on the Oceanic was usually made up with 11 or 14 hooks between floats. The Brothers usually set her lines with 14 hooks between buoys.

The float lines were made up of 40-pound tarred manila line with an A-K snap on the end and were either 10 or 25 fathoms in length. The floats used were of two types. One was the regular metal oxygen tank used by POFI and the other was 16-

inch diameter Japanese glass balls covered with netting. The droppers consisted of 2-1/2 fathoms of 16-pound tarred hemp, 1 fathom of galvanized wire leader and 9/10 hook.

Vessels: Oceanic and Brothers
Cruise No.: 2
Cruise period: July 14 to August 21, 1954
Gear: The gear used was identical with the gear used on the first cruise of the Oceanic and Brothers.

Vessel: Commonwealth
Cruise No.: 1
Cruise period: July 14 to August 21, 1954
Gear: The gear used was essentially the same as the gear used by the Oceanic and Brothers, but differed in several details. The mainlines used by the Commonwealth consisted of 5/64", 3 X 7 stainless steel cable. The floats were large Japanese glass balls. The float lines consisted of 10 fathoms of 9 thread Plymouth Manila (hard lay). The droppers consisted of 2 fathoms of 6 thread buoy Manila, 1 fathom of galvanized wire leader, and a 9/10 tuna hook. One basket was made up of 14 hooks.

Vessel: John R. Manning
Cruise No.: 20
Cruise period: May 11 to June 23, 1954
Gear: Whenever possible, equal numbers of POFI 11-hook cotton and steel gear were used. Other construction details were identifical.

Vessel: Sea Hawk
Cruise No.: 1
Cruise period: October 3 to 20, 1954
Gear: Ten-hook cotton gear (POFI design - 15-fathom hook spacing).

Vessel: Commonwealth
Cruise No.: 2
Cruise period: October 28 to November 22, 1954.
Gear: Both cotton and steel gear were used. The steel gear was composed of 100 hooks per reel and the cotton gear, 8 hooks per basket (POFI design - 15-fathom hook spacing).

Table 1.--List of common and scientific names of fishes used in this report

White-tipped shark, Pterolamiops longimanus (Poey)
Silky shark, Carcharhinus floridanus Bigelow, Schroeder and Springer
Great blue shark, Prionace glauca (Linnaeus)
Bonito shark, Isurus glaucus Müller and Henle
Marlin, Makaira sp.
Sailfish, Istiophorus orientalis (Temminck and and Schlegel)
Wahoo, Acanthocybium solandri (Cuvier and Valenciennes)
Dolphin, Coryphaena hippurus Linnaeus
Yellowfin tuna, Neothunnus macropterus (Temminck and Schlegel)
Bigeye tuna, Parathunnus sibi (Temminck and Schlegel)
Skipjack, Katsuwonus pelamis (Linnaeus)
Albacore, Germo alalunga (Bonnaterre)
Lancet fish, Alepisaurus sp.
Barracuda, Sphyraena barracuda (Walbaum)
Red snapper, Lutjanus bohar (Forskål)
Opah, Lampris sp.
Sunfish, Mola mola (Linnaeus)
Truncated sunfish, Ranzania truncata (Gmelin)
Broadbill swordfish, Xiphias gladius Linnaeus
Pelagic sting ray, Dasyatis atratus Ishiyama and Okada
Shortnosed spearfish, Tetrapturus angustirostris Tanaka

Table 2.--Summary of fishing localities and catches on 15-hook gear, North American cruise 1

Sta.	Date	Position[1]		Number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	1/27*	3°20'N.	154°45'W.	375	0	0	1	-	-	-	6	1 lancet fish
2	1/28	2°18'N.	157°05'W.	618	11 (2)[2]	1.8	-	-	1	3	16	
3	1/29	2°04'N.	157°50'W.	356	34 (8)	9.6	2	-	-	-	14	
4	2/1 *	1°42'N.	157°38'W.	630	26 (6)	4.1	-	-	-	-	-	
5	2/2	1°58'N.	157°34'W.	657	56 (7)	8.5	-	-	-	1	20	1 dolphin, 1 wahoo
6	2/3	2°01'N.	157°33'W.	738	56 (6)	7.6	-	-	-	-	22	1 dolphin, 1 wahoo
7	2/4	1°55'N.	157°36'W.	718	92 (7)	12.8	-	-	-	1	20	2 sailfish, 1 sunfish, 1 wahoo
8	2/5	1°50'N.	157°36'W.	858	49 (6)	5.7	1	-	-	-	8	2 dolphin, 1 sailfish
9	2/6 *	1°40'N.	157°17'W.	670	16	2.4	2	-	-	-	16	3 red snapper, 1 wahoo
10	2/7	1°52'N.	157°35'W.	873	73 (18)	8.4	-	-	-	1	31	1 barracuda, 1 wahoo
11	2/8	1°47'N.	157°30'W.	800	76 (6)	9.5	1	-	-	1	16	2 wahoo
12	2/9 *	2°02'N.	157°58'W.	840	46 (6)	5.5	-	-	1	1	5	1 lancet fish
13	2/10*	2°11'N.	158°04'W.	1,035	50 (5)	4.8	-	8	2	1	10	1 wahoo
14	2/11*	2°06'N.	157°42'W.	1,050	81 (1)	7.7	-	3	-	1	-	
15	2/12*	2°02'N.	157°52'W.	1,050	158 (1)	15.0	1	2	-	-	-	
16	2/13*	2°03'N.	158°15'W.	750	27 (2)	3.6	-	-	1	-	4	
17	2/14*	1°52'N.	157°34'W.	690	34 (4)	4.9	-	-	-	-	3	
18	2/16	1°56'N.	157°42'W.	975	58 (5)	5.9	-	-	1	-	11	2 wahoo
19	2/17	2°01'N.	157°46'W.	887	37	4.2	-	-	1	-	7	
20	2/18	2°08'N.	157°52'W.	863	30 (3)	3.5	2	-	3	-	16	
21	2/19*	2°04'N.	157°30'W.	1,020	22 (6)	2.2	-	-	-	-	14	
22	2/20	1°29'N.	157°36'W.	730	22 (2)	3.0	-	-	2	1	9	
23	2/21*	1°30'N.	157°15'W.	870	13 (2)	1.5	-	-	-	-	1	
24	2/22	1°51'N.	157°08'W.	720	28 (3)	3.9	-	-	-	1	21	1 lancet fish, 2 wahoo
25	2/23*	1°57'N.	156°54'W.	780	98 (24)	12.6	1	-	-	1	19	
26	2/24*	2°00'N.	158°05'W.	900	11 (1)	1.2	-	-	10	-	2	
27	2/25*	2°09'N.	157°23'W.	780	29 (3)	3.7	2	-	-	-	19	
28	2/26*	1°56'N.	157°15'W.	840	123 (12)	14.6	-	-	-	-	12	3 wahoo
29	2/27*	1°55'N.	157°11'W.	990	70 (3)	7.1	-	-	-	-	20	
30	2/28*	3°10'N.	157°23'W.	690	14 (7)	2.0	-	-	-	-	27	1 wahoo
Total				23,753	1,440 (156)	177.3	13	13	20	13	369	
Average					48.0 (5.2)	5.9	0.5	0.4	0.7	0.4	12.3	

* Indicates days no count of hooks was maintained.

[1] Position where first basket set. [2] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 3.--Summary of fishing localities and catches on 15-hook gear (from log maintained by Lars Jangaard), Alrita cruise 1

Sta.	Date	Noon position		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	1/27	3°20'N.	154°57'W.	390	0	0	3	-	-	-	6	
2	1/28	2°18'N.	157°20'W.	630	16 (1)[1/]	2.5	1	-	2	-	7	
3	1/29	2°10'N.	157°45'W.	930	11 (2)	1.2	1	-	-	-	15	
4	1/31	1°50'N.	157°40'W.	645	13 (2)	2.0	-	-	-	-	9	
5	2/1	1°50'N.	157°40'W.	600	24 (4)	4.0	-	-	-	1	12	
6	2/2	2°00'N.	157°35'W.	675	30 (3)	4.4	1	-	-	2	24	
7	2/3	2°00'N.	157°30'W.	750	29 (8)	3.9	-	-	-	-	25	
8	2/4	2°03'N.	157°32'W.	750	41 (5)	5.5	-	-	-	-	14	
9	2/5	2°05'N.	157°32'W.	900	111 (18)	12.3	-	-	-	-	33	
10	2/6	2°03'N.	157°32'W.	750	27 (2)	3.6	-	-	-	-	18	
11	2/7	2°03'N.	157°35'W.	900	46 (7)	5.1	-	-	-	1	6	
12	2/8	1°50'N.	157°35'W.	825	14	1.7	-	-	-	1	10	
13	2/9	2°06'N.	157°50'W.	900	103 (5)	11.4	-	-	1	-	12	1 sailfish
14	2/10	2°04'N.	158°10'W.	1,050	78 (3)	7.4	-	4	1	1	17	1 sailfish
15	2/11	1°51'N.	157°55'W.	1,050	115 (2)	11.0	2	4	-	-	12	
16	2/12	1°47'N.	157°55'W.	975	174 (1)	17.8	-	4	-	1	6	
17	2/13	2°00'N.	157°55'W.	825	26 (5)	3.2	-	-	-	1	9	1 wahoo
18	2/14	4 mi. off S.W. Pt., Christmas I.		825	38 (12)	4.6	-	-	-	-	26	
19	2/16	1°58'N.	157°45'W.	975	60	6.2	1	-	-	-	14	
20	2/17	2°05'N.	157°40'W.	900	45 (1)	5.0	1	-	2	-	10	
21	2/18	2°07'N.	157°50'W.	900	14	1.6	-	-	1	-	6	1 sailfish
22	2/19	2°03'N.	157°37'W.	900	12	1.3	-	-	-	1	12	
23	2/20	1°36'N.	157°30'W.	825	13 (2)	1.6	-	-	-	-	6	
24	2/21	1°25'N.	157°20'W.	870	3	0.3	-	-	-	-	5	
25	2/22	1°50'N.	157°07'W.	750	65 (27)	8.7	-	-	-	-	70	
26	2/23	1°50'N.	156°55'W.	750	73 (23)	9.7	-	-	-	-	46	
27	2/24	2°00'N.	157°58'W.	900	13 (2)	1.4	-	1	3	-	6	
28	2/25	5mi. N.W. of N.W. Pt.		900	20 (7)	2.2	-	-	-	-	32	
29	2/26	2°00'N.	157°08'W.	945	60 (2)	6.3	1	-	1	-	5	
30	2/27	1°55'N.	157°10'W.	900	49 (7)	5.4	-	-	-	-	8	
31	2/28	3°14'N.	157°08'W.	675	15 (1)	2.2	1	1	-	-	-	
Total				25,560	1,338 (152)	153.5	12	14	11	9	481	
Average					44 (4.9)	5.0	0.4	0.4	0.4	0.3	16	

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 4.--Summary of fishing localities and catches on 15-hook gear, North American cruise 2

Sta.	Date	Noon position		Number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	3/18	5°43'N.	162°16'W.	405	8 (2)1/	2.0	-	-	-	-	47	
2	3/19	4°56'N.	161°53'W.	675	8 (2)	1.2	-	-	2	2	5	
3	3/20	4°10'N.	159°57'W.	647	14 (4)	2.2	-	-	2	1	12	1 broadbill, 1 lancet fish, 1 wahoo
4	3/21*	2°52'N.	158°56'W.	900	6	0.7	-	-	5	-	16	2 wahoo
5	3/22	2°02'N.	157°56'W.	864	20 (1)	2.3	-	-	2	-	7	1 lancet fish
6	3/23*	5 mi. W. of Christmas I.		750	35 (5)	4.7	-	-	1	-	34	
7	3/24	7 mi. E. of N.E. Pt.		869	60 (10)	6.9	-	-	-	3	16	1 lancet fish, 1 wahoo
8	3/25*	7 mi. E. of N.E. Pt.		975	32 (4)	3.3	-	-	-	1	17	1 wahoo
9	3/26	15 mi. E. of N.E. Pt.		959	117 (21)	12.2	-	1	2	1	11	1 wahoo
10	3/27*	15 mi. E. of S.E. Pt.		990	87 (15)	8.8	1	-	3	3	16	1 wahoo
11	3/28	15 mi. E. of S.E. Pt.		924	59 (36)	6.4	-	-	-	4	29	
12	3/29*	15 mi. E. of S.E. Pt.		975	49 (3)	5.0	-	1	-	3	6	
13	3/30	1°20'N.	157°10'W.	918	87 (13)	9.5	-	-	1	1	17	1 lancet fish
14	3/31*	1°06'N.	157°00'W.	990	43 (3)	4.3	-	-	-	1	10	
15	4/1	10 mi. W. of Sta. 14		918	78 (7)	8.5	-	-	-	3	9	
16	4/2	1°06'N.	157°33'W.	944	52 (4)	5.5	-	-	2	2	9	
17	4/3	1°26'N.	157°50'W.	951	20 (6)	2.1	1	-	-	-	3	1 lancet fish
18	4/4	1°31'N.	157°28'W.	943	39 (5)	4.1	-	-	-	1	3	
19	4/5*	1°31'N.	157°10'W.	990	45 (8)	4.5	-	1	1	1	17	1 dolphin
20	4/6*	1°25'N.	156°52'W.	960	42 (1)	4.4	-	-	10	1	8	
21	4/8*	10 mi. E. of N.E. Pt.		990	18 (2)	1.8	-	-	2	-	9	2 wahoo
22	4/9*	1°10'N.	156°41'W.	990	25 (2)	2.5	-	-	8	1	12	
23	4/10	1°05'N.	156°33'W.	957	11 (1)	1.1	-	-	1	-	20	
24	4/11*	1°38'N.	157°39'W.	990	76 (8)	7.7	-	1	5	-	17	
25	4/12	1°37'N.	157°47'W.	900	58 (19)	6.4	-	-	4	1	17	1 sunfish
26	4/13*	1°33'N.	158°03'W.	885	37 (3)	4.2	-	3	11	1	9	
27	4/14	1°30'N.	157°41'W.	908	62 (7)	6.8	-	-	1	-	11	
28	4/15*	1°28'N.	157°33'W.	990	58 (6)	5.8	-	-	6	1	6	
29	4/16	1°10'N.	157°33'W.	935	48 (7)	5.1	1	1	7	-	9	
30	4/17	1°20'N.	157°22'W.	990	22	2.2	3	-	-	2	8	
31	4/18	20 mi. W. of London		933	40 (7)	4.3	1	-	1	-	16	1 lancet fish
32	4/19*	1°58'N.	157°48'W.	750	32 (2)	4.3	-	-	-	-	12	1 wahoo
33	4/20	8 mi. W. of Christmas I.		937	55 (15)	5.9	-	-	-	1	13	
34	4/21*	2°04'N.	157°57'W.	990	33 (2)	3.3	-	1	-	-	13	
35	4/22*	1°30'N.	157°37'W.	990	48 (3)	4.8	1	-	-	3	7	
36	4/24	10 mi. S. of S.W. Pt.		934	63 (3)	6.7	-	1	-	1	8	

* Indicates days no count of hooks was maintained.

1/ Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 4.--Summary of fishing localities and catches on 15-hook gear, North American cruise 2 (cont'd)

Sta.	Date	Noon position		Number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
37	4/25*	12 mi. S.W. of S.E. Pt.		990	66 (6)	6.7	-	-	-	2	9	
38	4/26	15 mi. S. of S.W. Pt.		884	36 (3)	4.1	-	-	-	-	9	
39	4/27	1°44'N.	156°23'W.	725	24 (5)	3.3	-	1	-	-	7	
40	4/28*	1°40'N.	155°09'W.	750	17 (2)	2.3	-	-	-	-	9	
Total				35,965	1,730 (253)	187.9	8	11	77	41	513	
Average					43.2 (6.3)	4.7	0.2	0.3	1.9	1.0	12.8	

* Indicates days no count of hooks was maintained.

Table 5.--Summary of fishing localities and catches on 15-hook gear (from log maintained by Lars Jangaard), Alrita cruise 2

Sta.	Date	Noon position		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	3/18	4 mi. S. of Palmyra I.		660	40 (14)[1/]	6.1	3	-	-	1	30	1 wahoo
2	3/19	5°07'N.	161°50'W.	750	8 (2)	1.1	3	-	-	-	6	1 wahoo
3	3/20	4°18'N.	160°10'W.	675	8	1.2	-	-	2	-	8	
4	3/21	2°55'N.	158°54'W.	900	12 (1)	1.3	-	-	5	-	10	
5	3/22	2°15'N.	158°00'W.	900	31 (1)	3.4	-	3	-	-	13	
6	3/23	2°04'N.	157°35'W.	900	12 (1)	1.3	-	1	-	1	20	
7	3/24	1°58'N.	157°08'W.	900	66 (3)	7.3	-	3	-	1	10	
8	3/25	1°56'N.	157°16'W.	975	33 (1)	3.4	-	1	-	4	6	
9	3/26	1°56'N.	157°00'W.	1,110	91 (10)	8.2	-	-	1	2	8	
10	3/27	1°43'N.	157°00'W.	1,050	88 (2)	8.4	-	-	-	1	11	
11	3/28	1°46'N.	157°00'W.	1,050	29 (1)	2.8	-	-	-	3	10	
12	3/29	1°36'N.	156°35'W.	1,050	38 (7)	3.6	-	-	-	1	9	
13	3/30	1°21'N.	157°10'W.	1,050	52 (2)	5.0	-	-	1	-	7	
14	3/31	1°05'N.	157°17'W.	1,050	52 (3)	5.0	-	-	-	-	9	
15	4/1	1°01'N.	157°51'W.	1,050	35 (10)	3.3	-	-	-	-	18	
16	4/2	1°19'N.	157°04'W.	900	24 (2)	2.7	-	1	2	-	3	1 broadbill
17	4/3	1°26'N.	157°50'W.	975	4 (3)	0.4	-	-	-	1	3	
18	4/4	1°30'N.	157°16'W.	975	16 (3)	1.6	1	-	1	-	13	
19	4/5	1°45'N.	157°00'W.	975	30 (8)	3.1	-	-	-	-	16	
20	4/6	1°18'N.	156°55'W.	900	20 (6)	2.2	-	-	10	1	6	
Total				18,795	689 (80)	71.4	7	9	22	16	216	
Average					34.4 (4.0)	3.6	0.4	0.4	1.1	0.8	10.8	

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 6.--Summary of fishing localities and catches on 6-hook gear, Charles H. Gilbert cruise 15

Sta.	Date	Noon position		Number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	2/19	32°19'N.	119°25'W.	114	-	-	-	-	-	-	9	
3	2/20	30°06'N.	119°43'W.	120	-	-	-	-	-	-	10	
5	2/21	27°54'N.	120°11'W.	180	-	-	-	-	-	-	58	
7*	2/22	25°58'N.	119°58'W.	180	-	-	-	-	-	-	2	3 opah
9*	2/23	23°54'N.	119°45'W.	180	-	-	-	-	-	-	-	1 opah
11*	2/24	21°47'N.	119°50'W.	180	-	-	-	-	-	-	1	4 opah
13*	2/25	19°47'N.	119°42'W.	179	-	-	-	-	-	-	-	1 dolphin
15*	3/3	08°59'N.	110°09'W.	180	1 (1)[1/]	0.6	-	-	-	2	7	1 dolphin
17*	3/4	07°20'N.	110°20'W.	180	1	0.6	-	-	1	1	5	2 sailfish
18*	3/5	05°04'N.	110°37'W.	178	4 (2)	2.2	2	-	-	-	14	1 sting ray
20*	3/6	03°44'N.	110°17'W.	171	7 (2)	4.1	4	-	-	-	3	
22*	3/7	02°26'N.	110°26'W.	179	-	-	-	-	-	-	3	4 lancet fish
24*	3/8	00°48'N.	110°55'W.	179	6	3.4	-	-	-	-	1	2 lancet fish
26*	3/9	00°59'S.	111°28'W.	150	10 (2)	6.7	-	-	-	-	2	
28*	3/10	03°22'S.	112°10'W.	149	1	0.7	1	-	-	-	-	
30*	3/11	05°17'S.	113°11'W.	150	-	-	-	-	1	-	1	
32*	3/12	07°08'S.	114°20'W.	142	1	0.7	19	-	-	-	-	
34	3/13	08°58'S.	114°48'W.	149	1	0.7	1	-	-	-	-	
36	3/15	09°20'S.	120°53'W.	150	1	0.7	3	1	-	1	-	
38	3/18	09°01'S.	131°23'W.	148	-	-	2	-	-	2	-	1 shortnosed spearfish
54	4/9	07°12'S.	155°16'W.	180	-	-	-	-	-	1	2	
56	4/10	05°34'S.	155°13'W.	179	4	2.2	-	1	-	-	1	
58	4/11	04°04'S.	155°21'W.	180	2	1.1	3	-	-	1	2	
60	4/12	02°56'S.	155°11'W.	178	-	-	2	1	-	-	2	
62	4/13	01°19'S.	155°08'W.	179	6	3.4	-	-	1	-	1	2 unident. tuna, 1 blackfish[2/]
64	4/14	00°25'N.	155°07'W.	176	9 (2)	5.1	-	-	-	1	2	
66	4/15	01°58'N.	155°16'W.	180	3	1.7	-	-	-	1	3	
68	4/16	01°48'N.	156°38'W.	179	11 (1)	6.1	-	-	-	-	3	
70	4/17	02°03'N.	157°48'W.	176	9 (2)	5.1	-	-	-	-	1	1 wahoo
71	4/20	02°55'N.	155°55'W.	179	7 (1)	3.9	-	-	2	-	4	
73	4/21	04°37'N.	155°05'W.	179	4 (1)	2.2	-	-	-	1	7	
75	4/22	06°03'N.	155°02'W.	180	3 (2)	1.7	1	-	-	-	4	
Total				5,383	91 (16)	52.9	38	3	5	11	148	
Average					2.8 (0.5)	1.6	1.2	0.1	0.2	0.3	4.6	

* Stations at which 1- and 10-fathom float lines were used.

1/ Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch. 2/ Globicephala sp.

Table 7.--Summary of fishing localities and catches on 11-hook gear, Charles H. Gilbert cruise 15

Sta.[1]	Number of hooks	Total catch							
		Yellowfin		Number of fish					
		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	220	-	-	-	-	-	-	14	
3	220	-	-	-	-	-	-	17	
5	329	-	-	-	-	-	-	122	
7*	330	-	-	-	-	-	-	3	3 opah
9*	329	-	-	-	-	-	-	3	2 opah
11*	328	-	-	-	-	-	-	3	2 opah, 1 dolphin
13*	330	-	-	-	-	-	-	2	2 dolphin
15*	330	-	-	1	-	-	1	15	1 sailfish
17*	330	1	0.3	2	-	-	-	7	1 sailfish, 1 lancet fish, 1 wahoo
18*	325	12 (3)[2]	3.7	5	-	-	2	14	
20*	327	17 (6)	5.2	1	-	-	1	6	
22*	329	-	-	1	-	-	-	7	5 lancet fish
24*	327	13 (1)	4.0	-	-	-	-	2	2 lancet fish
26*	275	7	2.5	-	-	-	1	4	
28*	275	-	-	3	-	-	2	1	1 wahoo
30*	275	1	0.4	2	-	5	-	2	
32*	266	-	-	19	-	1	2	1	1 sting ray
34	273	-	-	-	-	-	-	-	
36	270	2 (1)	0.7	3	1	-	1	-	
38	274	-	-	1	1	-	1	-	
54	330	1	0.3	-	-	1	1	1	
56	329	1	0.3	-	1	1	-	1	1 wahoo
58	328	3	0.9	-	1	-	-	4	1 wahoo
60	326	1	0.3	-	2	-	-	1	
62	330	6	1.8	-	1	-	-	4	1 unidentified tuna
64	326	9	2.8	-	-	-	-	3	
66	328	3	0.9	-	1	1	-	4	1 sunfish
68	327	12	3.7	-	1	1	1	2	
70	314	24 (7)	7.6	-	1	2	-	7	
71	325	11	3.4	-	-	-	1	2	
73	319	1 (1)	0.3	1	-	1	-	4	
75	329	2	0.6	1	-	-	1	5	
Total	9,873	127 (19)	39.7	40	10	13	15	261	
Average		4.0 (0.6)	1.2	1.2	0.3	0.4	0.5	8.2	

* Stations at which 1- and 10-fathom float lines were used.

[1] Dates and positions of these stations given in table 6.

[2] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 8.--Summary of fishing localities and catches on steel gear, John R. Manning cruise 20

Sta.	Date	Noon position		Number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	5/17	5°58.0'N.	162°52.5'W.	323	6	1.8	-	-	-	-	4	
2	5/18	6°02.0'N.	162°27.5'W.	327	1	0.3	-	-	-	1	1	
4	5/19	6°07.5'N.	162°12.5'W.	323	1	0.3	5	-	-	-	4	
5	5/20	5°49.4'N.	161°36.4'W.	330	1 (1)[1/]	0.3	-	-	-	-	5	1 lancet fish
6	5/21	5°57.5'N.	161°11.0'W.	330	-	-	1	-	-	1	5	
8	5/22	5°26.5'N.	161°36.7'W.	326	-	-	-	-	-	-	2	
10	5/23	4°55.0'N.	161°19.0'W.	321	3	0.9	-	-	-	1	3	1 wahoo, 1 lancet fish
12	5/24	4°56.0'N.	160°32.0'W.	312	6 (3)	1.9	1	-	-	-	13	
13	5/25	4°45.3'N.	160°11.0'W.	320	13 (2)	4.1	-	-	-	-	24	
15	5/26	4°52.0'N.	159°35.0'W.	216	2	0.9	1	-	-	-	5	
17	5/27	4°17.0'N.	160°27.5'W.	215	1	0.5	-	-	-	-	1	1 broadbill
19	5/28	4°02.0'N.	159°34.2'W.	214	1	0.4	-	-	-	1	1	
21	5/30	3°58.5'N.	159°04.1'W.	214	25 (6)	11.7	1	-	-	-	3	
23	5/31	4°07.9'N.	158°20.5'W.	221	-	-	1	-	-	-	1	
25	6/1	3°04.1'N.	159°12.3'W.	219	3	1.4	-	2	-	-	2	
27	6/2	2°29.0'N.	158°21.9'W.	214	3	1.4	-	1	1	-	1	1 barracuda, 1 lancet fish
29	6/3	1°43.0'N.	158°27.5'W.	218	3	1.4	-	-	-	-	8	
31	6/4	2°03.1'N.	157°39.5'W.	207	14 (7)	6.8	-	-	-	-	10	
33	6/7	1°52.0'N.	156°47.8'W.	215	5 (1)	2.3	-	-	1	-	3	
35	6/8	2°01.4'N.	157°09.0'W.	213	14 (3)	6.6	-	-	-	-	1	
36	6/9	1°47.0'N.	158°15.7'W.	211	3 (1)	1.4	-	-	-	-	3	
38	6/10	0°50.5'N.	158°52.6'W.	210	3	1.4	-	-	-	-	14	
40	6/11	0°26.0'S.	158°56.9'W.	211	3	1.4	1	-	-	-	10	
42	6/12	0°13.5'S.	160°00.5'W.	197	13 (3)	6.6	-	-	-	-	17	1 wahoo
43	6/13	0°17.9'S.	160°16.0'W.	216	-	-	-	-	-	1	5	
45	6/14	0°13.2'S.	160°02.2'W.	217	4 (2)	1.8	-	-	-	-	11	
46	6/15	0°29.5'S.	160°19.2'W.	212	4	1.9	-	1	-	-	1	
Total				6,752	132 (29)	57.5	11	4	2	5	162	
Average					4.9 (1.1)	2.1	0.4	0.1	0.1	0.2	6	

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 9.--Summary of fishing localities and catches on 11-hook cotton gear, John R. Manning cruise 20

Sta.[1]	Number of hooks	Total catch							
		Yellowfin		Number of fish					
		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	328	2 (1)[2]	0.6	-	-	-	-	2	1 lancet fish
2	321	12 (5)	3.7	-	-	1	1	17	
4	330	-	-	2	-	-	-	4	
5	272	-	-	-	-	-	-	1	2 barracuda
6	323	-	-	-	-	-	1	5	1 lancet fish, 1 leather-back turtle[3]
8	329	1	0.3	2	-	-	-	3	
10	325	4	1.2	-	-	-	-	-	1 wahoo
12	329	-	-	-	-	-	-	7	1 lancet fish
13	318	16 (10)	5.0	-	-	-	1	28	
15	438	3	0.7	-	-	-	-	8	1 wahoo, 1 lancet fish
17	433	29 (6)	6.7	-	-	-	-	8	
19	421	58 (23)	13.8	1	-	-	1	21	
21	327	26	8.0	-	-	-	-	9	
23	325	1	0.3	-	-	1	-	7	1 lancet fish
25	326	4	1.2	1	-	-	-	2	
27	328	2	0.6	-	-	-	-	2	
29	325	5 (2)	1.5	-	-	4	-	11	
31	322	10 (2)	3.1	-	-	-	-	14	
33	328	2 (1)	0.6	-	1	1	-	5	
35	325	22 (6)	6.8	-	1	-	-	21	
36	329	3 (1)	0.9	-	-	-	1	9	
38	316	23 (4)	7.3	-	-	-	1	12	
40	322	5 (2)	1.6	-	1	-	1	4	
42	328	16 (2)	4.9	-	-	-	-	8	
43	318	29 (8)	9.1	-	-	-	-	25	
45	323	14 (5)	4.3	-	-	-	1	17	
46	303	6	2.0	-	-	-	-	3	
Total	9,012	293 (78)	84.2	6	3	6	8	253	
Average		0.9 (2.9)	3.1	0.2	0.1	0.2	0.3	9.3	

[1] Dates and positions of these stations given in table 8.

[2] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

[3] Dermochelys schlegelii (Garman)

Table 10.--Summary of fishing localities and catches on steel gear, Oceanic and Brothers cruise 1

Brothers[1/]

Sta.	Date	Noon position		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Albacore	Skipjack	Marlin	Shark	Miscellaneous
1	6/3	3°53'N.	159°29'W.	200	10 (8)[2/]	5.0	-	-	-	1	17	
2	6/4	3°55'N.	159°28'W.	300	13 (7)	4.3	-	-	-	-	22	
3	6/5	3°54'N.	159°32'W.	300	15 (6)	5.0	-	-	-	-	14	
4	6/7	1°58'N.	157°37'W.	No data								
5	6/8	2°02'N.	157°33'W.	400	16 (10)	4.0	-	-	-	-	24	
6	6/9	1°58'N.	157°37'W.	400	17 (10)	4.2	-	-	-	-	25	
7	6/11	3°53'N.	159°28'W.	200	21 (5)	10.5	-	-	-	-	6	
8	6/12	3°55'N.	159°28'W.	400	7 (5)	1.8	-	-	-	-	7	
9	6/13	3°58'N.	159°28'W.	400	11 (7)	2.8	-	-	-	-	15	
10	6/14	3°55'N.	159°30'W.	400	7 (3)	1.8	-	-	-	3	10	
Total				3,000	117 (61)	39.4	-	-	-	4	140	
Average					13.0 (6.8)	4.4	-	-	-	0.4	15.6	

Oceanic

1	6/3	3°55'N.	159°28'W.	279	1	0.4	-	-	-	-	3	
2	6/4	3°50'N.	159°28'W.	460	12 (6)	2.6	-	-	-	1	4	
3	6/5	3°51'N.	159°32'W.	456	3 (1)	0.6	-	-	-	-	7	
4	6/7	2°02'N.	157°35'W.	460	3 (3)	0.6	-	-	-	-	40	
5	6/8	1°56'N.	157°35'W.	378	4	1.0	-	-	-	2	9	
6	6/9	1°54'N.	157°37'W.	475	5 (3)	1.0	-	-	-	-	32	1 wahoo
7	6/11	3°50'N.	159°28'W.	475	5 (2)	1.0	-	-	-	1	10	
8	6/12	4°02'N.	159°25'W.	383	13 (9)	3.4	-	-	-	-	36	
9	6/13	3°55'N.	159°36'W.	482	10 (2)	2.1	2	-	-	-	6	
10	6/14	3°53'N.	159°39'W.	389	3 (1)	0.8	-	-	-	-	4	
Total				4,237	59 (27)	13.5	2	-	-	4	151	
Average					5.9 (2.7)	1.4	0.2	-	-	0.4	15.0	

1/ The data from the Brothers may not be entirely accurate. No detailed record was kept and the daily fishing log was filled out a few days later from memory by the captain of the Brothers.

2/ Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 11.--Summary of fishing localities and catches on steel gear, Commonwealth cruise 1

Sta.	Date	Noon position[1]		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	7/26	3°43'N.	159°36'W.	300	3	1.0	-	-	-	-	2	
2	7/28	2°23'N.	158°19'W.	500	5 (1)[2]	1.0	1	-	2	-	1	1 broadbill
3	7/29	1°51'N.	158°05'W.	600	2	0.3	-	-	-	1	10	
4	8/3	1°55'N.	158°10'W.	600	13 (2)	2.2	-	-	-	-	12	
5	8/4	1°54'N.	157°43'W.	600	8 (1)	1.3	2	-	-	-	14	2 dolphin
6	8/5	1°49'N.	157°10'W.	600	15 (3)	2.5	3	-	2	2	9	2 wahoo
7	8/6	1°19'N.	156°47'W.	500	10	2.0	-	1	2	-	8	1 wahoo
8	8/7	1°06'N.	156°27'W.	600	20 (3)	3.3	-	-	1	1	9	
9	8/8	1°05'N.	156°24'W.	200	-	-	-	-	-	-	12	
10	8/9	1°15'N.	156°40'W.	500	10	2.0	1	-	1	1	3	
11	8/11	1°32'N.	156°33'W.	500	13 (5)	2.6	-	-	1	-	7	
Total				5,500	99 (15)	18.2	7	1	9	5	87	
Average					9.1 (1.4)	1.6	0.5	0.1	0.8	0.4	8.2	

[1] Position when first basket was hauled.

[2] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 12.--Summary of fishing localities and catches on steel gear, Brothers cruise 2

Sta.	Date	Noon positon		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	7/26	3°58'N.	159°30'W.	500	5 (1)[1/]	1.0	1	-	1	1	5	
2	7/28	3°15'N.	159°30'W.	500	12	2.4	-	-	1	-	7	
3	7/29	3°19'N.	159°09'W.	500	1 (1)	0.2	-	-	-	-	2	
4	8/3	15 mi. W. of London		200	-	-	-	-	-	-	3	
5	8/5	6 mi. W. of London		500	2 (1)	0.4	-	-	-	-	8	
6	8/6	15 mi. W. of London		500	9 (1)	1.8	-	-	-	-	6	1 sailfish
7	8/9	14 mi. S.W. of Bridges Pt.		400	7 (3)	1.8	-	-	-	-	13	
8	8/11	42 mi. S.E. of Fanning I.		100	-	-	-	-	-	-	1	
Total				3,200	36 (7)	7.6	1	-	2	1	45	
Average					4.5 (0.9)	1.0	0.1	-	0.2	0.1	5.6	

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 13.--Summary of fishing localities and catches, Oceanic cruise 2

Sta.	Date	Noon position		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	7/26	9 mi. W. xS. of Fanning I.		600	7 (1)[1/]	1.2	-	-	1	-	7	
2	7/28	2°20'N.	158°14'W.	600	10	1.7	-	-	1	-	4	
3	7/29	30 mi. W. xN. of Christmas I.		600	11 (1)	1.8	-	-	1	-	8	2 dolphin
4	8/3	6 mi. N.W. of S.W. Pt.		600	11 (4)	1.8	-	-	-	-	22	
5	8/5	10 mi. W. of Christmas I.		600	20 (2)	3.3	-	-	-	-	12	
6	8/6	10 mi. W. xS. of Christmas I.		600	11 (4)	1.8	-	-	-	-	8	
7	8/7	3 mi. S.W. of Christmas I.		500	1 (1)	0.2	-	-	-	-	7	
8	8/8	6 mi. S.W. of Christmas I.		500	17 (2)	3.4	1	-	-	-	2	
9	8/9	8 mi. S. of Christmas I.		500	12	2.4	-	-	-	-	8	
10	8/11	50 mi. S.E. of Fanning I.		500	4	0.8	-	-	-	-	7	
Total				5,600	104 (15)	18.4	1	-	3	-	85	
Average					10.4 (1.5)	1.8	0.1	-	0.3	-	8.5	

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 14.--Summary of fishing localities and catches on 10-hook gear, Sea Hawk cruise 1

Sta.	Date	Noon position		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Shark	Miscellaneous
1	10/3	3°45'N.	155°50'W.	500	5 (1)[1/]	1.0	-	-	-	1	37	
2	10/4	2°55'N.	156°12'W.	350	2	0.6	-	-	-	-	12	1 sunfish
3	10/5	40 mi. N. E. of Christmas I.		470	10 (1)	2.1	-	-	-	1	9	
4	10/6	40 mi. N. W. of Christmas I.		380	1	0.3	-	-	1	2	10	
5	10/8	15 mi. N. W. of Christmas I.		500	15 (6)	3.0	-	-	-	2	21	
6	10/9	15 mi. N. W. of Christmas I.		380	1	0.3	-	-	-	1	6	
7	10/10	2°07'N.	157°55'W.	460	9 (2)	2.0	-	-	-	-	9	
8	10/11	2°06'N.	157°25'W.	500	4 (2)	0.8	-	-	-	2	4	
9	10/13	0°50'N.	156°30'W.	500	7	1.4	-	-	-	-	17	
10	10/14	0°25'N.	157°43'W.	500	2	0.4	-	-	-	-	-	
11	10/15	1°56'N.	156°59'W.	500	1	0.2	-	-	-	-	9	
12	10/20	4°00'N.	157°15'W.	500	1	0.2	-	-	2	-	2	
Total				5,540	58 (12)	12.3	-	-	3	9	136	
Average					4.8 (1.0)	1.0	-	-	0.2	0.8	11.3	

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 15.--Summary of fishing locations and catches on steel and 11-hook cotton gear, Commonwealth cruise 2

Sta.	Date	Noon position		Estimated number of hooks	Total catch							
					Yellowfin		Number of fish					
		Latitude	Longitude		Number	Per 100 h.	Big-eye	Alba-core	Skip-jack	Marlin	Sharks	Miscellaneous
1*	10/28	1°10'N.	157°19'W.	600	1	0.2	1	-	1	1	14	
2*	10/29	2°14'N.	156°33'W.	600	20 (13)[1/]	3.3	-	-	-	1	17	
3*	10/30	2°30'N.	156°51'W.	300	7 (1)	2.3	-	-	-	-	14	
4	10/31	30 mi. N.W. of Christmas I.		400	17 (6)	4.2	-	-	-	-	14	1 wahoo
5	11/1	30 mi. N.W. of Christmas I.		480	18 (1)	3.8	-	-	-	-	7	
6	11/2	30 mi. N.E. of Christmas I.		496	5	1.0	-	-	-	-	8	
7	11/3	30 mi. S.E. of Christmas I.		480	11 (4)	2.3	-	-	-	1	-	
8*	11/4	1°42'N.	156°30'W.	550	12 (7)	2.2	-	-	-	1	14	
9	11/8	2°08'N.	157°49'W.	472	8 (2)	1.7	-	-	-	-	9	
10	11/12	30 mi. N.W. of Fanning I.		544	19 (11)	3.5	-	-	-	1	31	
11	11/13	4°13.5'N.	159°15'W.	544	25 (3)	4.6	1	-	-	-	16	
12	11/14	3°33'N.	158°27'W.	540	5 (2)	0.9	-	-	-	2	3	
13	11/15	4°08.4'N.	159°44'W.	544	13 (8)	2.4	-	-	1	3	15	
14	11/16	30 mi. N. E. of Fanning I.		400	14 (1)	3.5	-	-	-	-	10	
15	11/22	60 mi. S.W. of Palmyra I.		520	3 (1)	0.6	-	-	-	-	19	2 barracuda
Total				7,470	178 (60)	36.5	2	-	2	10	191	
Average					11.9 (4.0)	2.4	0.1	-	0.1	0.7	13.6	

* Stations at which steel gear was fished.

[1/] Numbers in parentheses are shark-damaged fish and are included in the adjacent daily catch.

Table 16.--Yellowfin catch by hook number, North American cruise 1 (see fig. 20 - Appendix)

Sta.	Hook Number															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
2	-	1	-	-	-	1	2	1	3	1	1	-	-	-	1	11
3	2	1	-	1	2	3	5	4	5	3	2	5	1	-	-	34
5	2	2	3	4	6	3	1	7	7	5	6	2	4	3	1	56
6	3	3	5	6	4	8	5	4	4	3	5	2	2	1	1	56
7	5	3	5	9	6	5	8	8	9	6	6	3	4	5	5	87
8	4	4	2	3	5	-	8	4	2	6	5	2	1	1	2	49
10	1	5	3	5	6	4	5	8	6	4	3	6	4	2	2	64
11	5	3	5	8	7	5	8	3	5	5	2	6	6	4	4	76
18	-	2	1	2	2	3	-	3	2	3	1	-	-	-	-	19
19	2	2	1	4	2	-	8	1	7	4	2	-	-	2	1	36
20	-	-	1	3	5	3	7	4	3	1	2	-	1	-	-	30
22	2	-	3	3	2	1	4	-	2	-	-	2	3	-	-	22
Total	26	26	29	48	47	36	61	47	55	41	35	28	26	18	17	540
%	4.8	4.8	5.4	8.9	8.7	6.7	11.3	8.7	10.2	7.6	6.5	5.2	4.8	3.3	3.1	100

Table 17.--Length frequencies of yellowfin taken on fabric gear on four cruises in the central Pacific (Line Islands), 1954

Fork length (cm.)	Male					Female				
	Manning 20	Gilbert 15*	N. Am. 2	N. Am. 1	Total	Manning 20	Gilbert 15*	N. Am. 2	N. Am. 1	Total
54-55	-	-	-	-	-	-	-	1	-	1
56-57	-	-	-	-	-	-	-	-	-	-
58-59	-	-	-	-	-	-	-	-	-	-
60-61	-	-	-	-	-	-	-	-	-	-
62-63	-	-	-	-	-	-	-	-	-	-
64-65	-	-	-	-	-	-	-	-	-	-
66-67	-	-	-	-	-	-	-	-	-	-
68-69	-	-	-	1	1	-	-	-	-	-
70-71	-	-	-	3	3	-	-	1	5	6
72-73	-	-	-	4	4	-	-	-	3	3
74-75	-	-	1	2	3	-	-	1	-	1
76-77	-	-	2	1	3	-	-	1	-	1
78-79	1	-	2	-	3	-	-	-	1	1
80-81	-	-	2	-	2	-	-	-	-	-
82-83	1	-	3	-	4	-	-	1	-	1
84-85	-	-	3	1	4	-	1	2	-	3
86-87	2	1	1	-	4	-	-	4	-	4
88-89	3	-	1	-	4	2	-	3	-	5
90-91	2	1	-	2	5	1	-	-	2	3
92-93	3	-	3	-	6	5	-	2	-	7
94-95	1	-	2	-	3	-	-	-	1	1
96-97	3	-	1	2	6	2	-	3	1	6
98-99	2	-	3	6	11	2	1	4	-	7
100-101	3	-	3	5	11	5	-	7	3	15
102-103	3	-	6	2	11	4	-	9	6	19
104-105	3	1	6	5	15	1	1	7	11	20
106-107	8	-	1	10	19	2	-	7	11	20

* Stations 54-75 only.

Table 17.--Length frequencies of yellowfin taken on fabric gear on four cruises in the central Pacific (Line Islands), 1954 (cont'd)

Fork length (cm.)	Male					Female				
	Manning 20	Gilbert 15	N. Am. 2	N. Am. 1	Total	Manning 20	Gilbert 15	N. Am. 2	N. Am. 1	Total
108-109	2	-	9	16	27	2	-	3	12	17
110-111	4	-	8	17	29	2	-	3	12	17
112-113	7	-	7	6	20	1	-	5	10	16
114-115	6	-	4	6	16	4	-	4	8	16
116-117	10	-	3	7	20	5	-	6	4	15
118-119	5	-	3	2	10	3	-	2	-	5
120-121	7	-	6	1	14	5	1	-	-	6
122-123	2	1	1	-	4	4	1	3	-	8
124-125	4	1	3	2	10	-	2	5	-	7
126-127	3	-	3	1	7	2	-	2	2	6
128-129	2	1	2	3	8	4	-	2	-	6
130-131	-	2	5	1	8	-	1	5	1	7
132-133	1	2	4	2	9	5	-	7	-	12
134-135	2	1	6	1	10	2	2	6	1	11
136-137	5	-	2	1	8	-	3	13	1	17
138-139	3	1	10	2	16	3	2	11	4	20
140-141	2	2	11	1	16	5	5	29	4	43
142-143	2	1	14	5	22	4	6	29	3	42
144-145	6	1	27	3	37	2	7	27	6	42
146-147	9	8	41	18	76	5	6	35	2	48
148-149	9	7	33	14	63	2	3	20	3	28
150-151	5	4	33	11	53	3	5	24	-	32
152-153	4	5	32	5	46	-	1	7	-	8
154-155	3	1	19	1	24	-	-	10	-	10
156-157	2	3	15	1	21	-	1	8	-	9
158-159	3	6	16	1	26	-	2	3	-	5
160-161	1	3	12	-	16	-	-	-	-	-
162-163	2	4	7	-	13	-	-	-	-	-
164-165	1	2	5	-	8	-	1	-	-	1
166-167	-	-	2	-	2	-	-	-	-	-
168-169	-	1	1	-	2	-	-	-	-	-
170-171	-	-	-	-	-	-	-	-	-	-
Total	147	60	384	172	763	87	52	322	117	578

Table 18.--Results of Japanese commercial longline fishing in the central Pacific during 1954 (data from Nomura 1954-55)

Area	Sta.	Boats	Baskets	Hooks	Average catch per 100 hooks										
					Yellow-fin	Big-eye	Alba-core	Skip-jack	Black marlin	White marlin	Striped marlin	Broad-bill	Sail-fish	Shark	Misc.
						JANUARY									
10°-11°N. 174°W.	17	1	6,120	24,480	0.41	4.04	0.06	-	0.19	-	0.01	0.04	-	-	-
29°-30°N. 179°-170°W.	20	1	5,868	29,340	0.01	1.42	2.34	0.06	-	-	0.04	0.11	-	0.18	-
30°-32°N. 170°-169°W.	18	1	6,230	31,150	-	1.63	0.72	0.31	-	-	0.05	0.12	-	-	0.02
						FEBRUARY									
10°-11°N. 176°-174°W.	18	1	6,480	32,400	0.34	3.10	0.12	-	0.25	0.02	0.01	0.01	-	-	0.02
23°-30°N. 171°-158°W.	28	1	8,720	43,600	0.08	1.14	0.03	0.01	0.10	0.02	0.08	0.11	-	0.03	-
						MARCH									
8°-12°N. 180°-165°W.	103	5	37,000	180,072	0.22	1.90	0.11	-	0.36	-	0.04	0.01	0.01	-	-
0°-11°N. 179°-166°W.	25	1	8,355	41,775	2.22	0.87	0.08	-	0.32	-	0.05	-	0.01	0.20	0.15
						APRIL									
8°-12°N. 179°-164°W.	243	12	89,528	421,344	0.13	2.39	0.06	0.04	0.43	0.01	0.05	0.02	0.02	-	0.10
0°-4°N. 178°-170°W.	85	4	32,335	140,857	3.07	0.50	0.21	0.03	0.40	0.03	0.02	0.01	-	-	-
2°N.-11°S. 177°-169°W.	34	1	13,490	53,960	3.93	0.72	0.57	0.10	0.37	0.05	0.01	0.02	0.01	-	0.02
						MAY									
9°-12°N. 170°W.-180°	27	2	9,805	49,025	0.07	2.57	0.01	0.02	0.78	0.01	-	0.02	-	-	-
5°S.-11°N. 169°-178°W.	20	1	7,200	36,000	1.99	1.43	0.28	0.09	0.43	0.04	0.03	0.01	-	-	-
3°N.-7°S. 155°-169°W.	29	1	12,319	43,704	6.54	0.40	0.59	-	0.38	0.08	0.02	0.02	-	-	-

Table 18.--Results of Japanese commercial longline fishing in the central Pacific during 1954 (data from Nomura 1954-55) (cont'd)

Area	Sta.	Boats	Baskets	Hooks	Average catch per 100 hooks										
					Yellow-fin	Big-eye	Alba-core	Skip-jack	Black marlin	White marlin	Striped marlin	Broad-bill	Sail-fish	Shark	Misc.
						JUNE									
0°-13°N. 157°-177°W.	113	4	45,108	180,096	0.36	2.63	0.01	0.05	0.72	0.01	0.05	0.01	0.02	0.69	0.33
2°N.-(3°S.) 170°-177°W.	49	1	20,050	80,200	3.72	0.21	0.43	0.05	0.22	0.04	0.01	0.01	-	0.18	-
1°-3°N. 157°-165°W.	36	1	14,400	64,800	2.20	0.93	0.19	-	0.40	0.02	-	0.19	-	-	-
						JULY									
6°-11°N. 179°-163°W.	46	1 (2)	17,451	71,253	0.38	2.01	-	-	0.83	-	-	0.01	-	-	0.01
1°-8°N. 179°-155°W.	136	6	52,100	232,345	3.99	0.54	0.11	0.05	0.35	0.03	-	0.01	0.03	0.05	0.03
0°-4°N. 166°-150°W.	66	2	24,360	121,800	5.80	0.26	0.22	0.02	0.21	0.03	0.03	-	-	-	0.16
1°-7°S. 178°-160°W.	57	2	22,620	100,740	2.78	0.58	0.11	0.22	0.37	0.02	0.01	0.02	0.05	0.26	0.04
						AUGUST									
6°-8°N. 136°-135°W.	25	1	10,223	51,115	2.45	2.63	-	-	0.30	0.05	0.03	0.01	-	-	0.02
6°-11°N. 174°-171°W.	18	1	6,660	26,640	0.57	1.55	-	-	1.31	0.01	-	-	-	-	0.38
0°-12°N. 180°-167°W.	37	1	14,275	57,100	2.43	0.91	0.12	-	0.65	0.03	0.01	-	0.01	0.20	0.03
2°S.-10°N. 162°-151°W.	34	1	13,764	53,950	1.87	1.75	0.01	-	0.99	0.02	-	0.01	-	0.64	0.01
						SEPTEMBER									
5°-11°N. 176°-172°W.	83	4	30,800	154,000	0.42	1.20	0.01	0.05	0.83	0.01	-	0.01	0.05	-	0.05
37°-39°N. 180°-177°W.	20	1	4,230	20,960	0.04	2.17	0.52	-	0.01	-	0.07	0.04	-	0.13	0.01
						OCTOBER									
4°-12°N. 178°-157°W.	84	4	31,329	146,012	0.25	1.12	0.01	-	0.50	0.01	0.01	-	0.01	0.01	-

Table 18.--Results of Japanese commercial longline fishing in the central Pacific during 1954 (data from Nomura 1954-55) (cont'd)

Area	Sta.	Boats	Baskets	Hooks	Average catch per 100 hooks										
					Yellow-fin	Big-eye	Alba-core	Skip-jack	Black marlin	White marlin	Striped marlin	Broad-bill	Sail-fish	Shark	Misc.
					OCTOBER (cont'd)										
24°-32°N. 178°-168°W.	96	4	34,047	144,869	0.08	1.32	0.03	-	0.09	-	0.07	0.01	-	0.04	0.01
27°-39°N. 180°-167°W.	97	4	33,887	156,645	0.03	1.24	1.76	-	0.03	-	0.05	0.05	-	0.05	0.01
					NOVEMBER										
5°-9°N. 145°-133°W.	149	5	55,789	250,774	0.53	3.45	0.01	0.20	0.41	0.02	0.05	0.04	0.05	0.20	-
25°-32°N. 180°-163°W.	200	10	63,460	300,730	0.16	1.85	0.13	-	0.06	-	0.08	0.02	-	0.07	0.04
0°-16°S. 175°-176°W.	26	1	9,576	47,880	1.10	0.14	1.65	-	0.77	0.01	0.06	0.01	0.02	-	-
					DECEMBER										
5°-10°N. 142°-130°W.	99	3	37,924	163,166	0.96	3.73	-	0.06	0.24	0.01	0.10	0.03	0.05	0.12	0.02
7°-8°N. 148°-140°W.	14	1	5,695	23,480	0.22	2.95	-	-	0.51	0.01	-	0.04	0.04	-	-
28°-34°N. 180°-167°W.	203	9	65,592	316,753	-	1.95	0.91	-	0.01	-	0.06	0.12	-	0.25	0.02
25°-34°N. 170°-164°W.	134	6	43,075	195,455	0.11	2.11	0.15	-	0.03	-	0.04	0.03	-	0.11	0.01
4°-11°N. 175°-171°W.	14	1	4,692	23,460	0.43	1.37	-	-	0.14	0.01	0.02	-	0.01	-	-
19°-22°S. 174°-171°W.	19	1	6,485	32,425	1.07	0.09	6.00	0.04	0.79	0.02	0.43	0.02	0.02	-	0.30

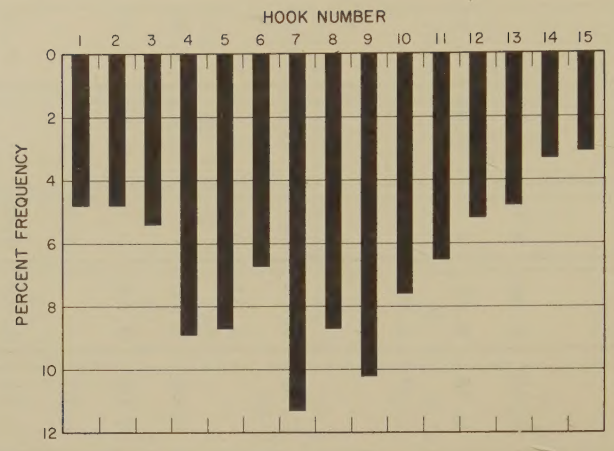

Figure 20.--Percentage of yellowfin catch by hook number (hence relative depth) on North American cruise 1, illustrating the prevalence of higher catch rates on the deeper hooks.

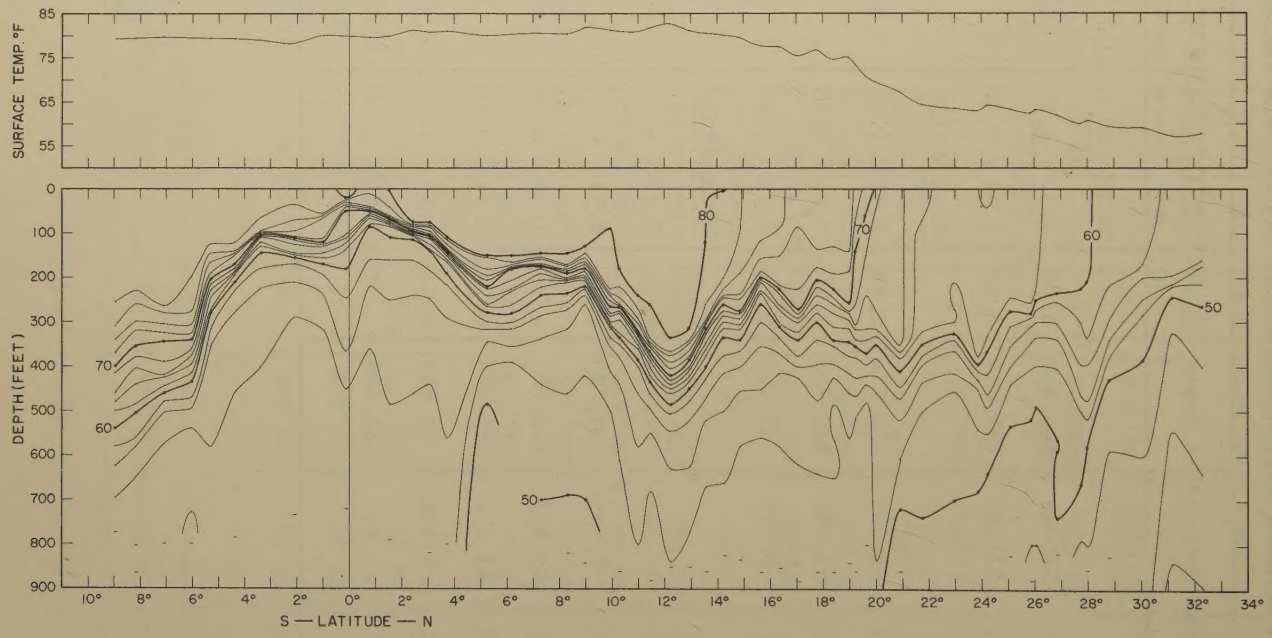

Figure 21.--Surface temperature and vertical temperature section along 120°W. and 109°W. longitude, February-March (Charles H. Gilbert cruise 15). Upper panel--surface temperatures as read at each bathythermograph lowering. Lower panel--temperature section based on bathythermograph lowerings; isotherms at 2°F. intervals, depth of lowering shown by horizontal dashes.

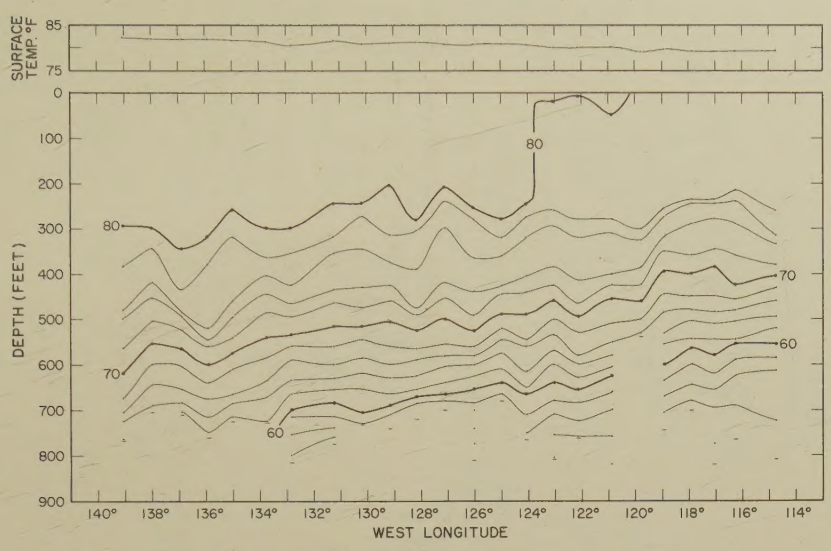

Figure 22.--Surface temperature and vertical temperature section along 9°S. latitude from 115°W. longitude to the Marquesas Islands, March (Charles H. Gilbert cruise 15). Upper panel--surface temperatures as read at each bathythermograph lowering. Lower panel--temperature section based on bathythermograph lowering; isotherms at 2°F. intervals, depth of lowering shown by horizontal dashes.

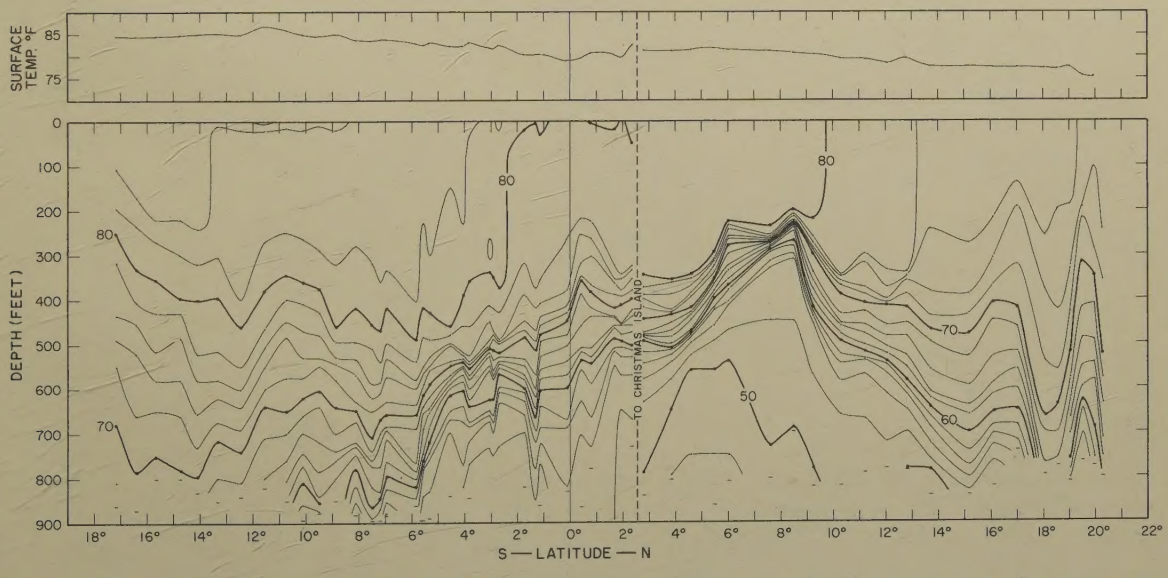

Figure 23.--Surface temperature and vertical temperature section along a south-north section between 149°W. and 157°W. longitude, April (Charles H. Gilbert cruise 15). Upper panel--surface temperatures as read at each bathythermograph lowering. Lower panel--temperature section based on bathythermograph lowering; isotherms at 2°F. intervals, depth of lowering shown by horizontal dashes.